

FIGURE H-2-36. Interaction of Initial Dioxin and Race for MCMII Hypomania Score (Ranch Hands, Maximal Assumption)

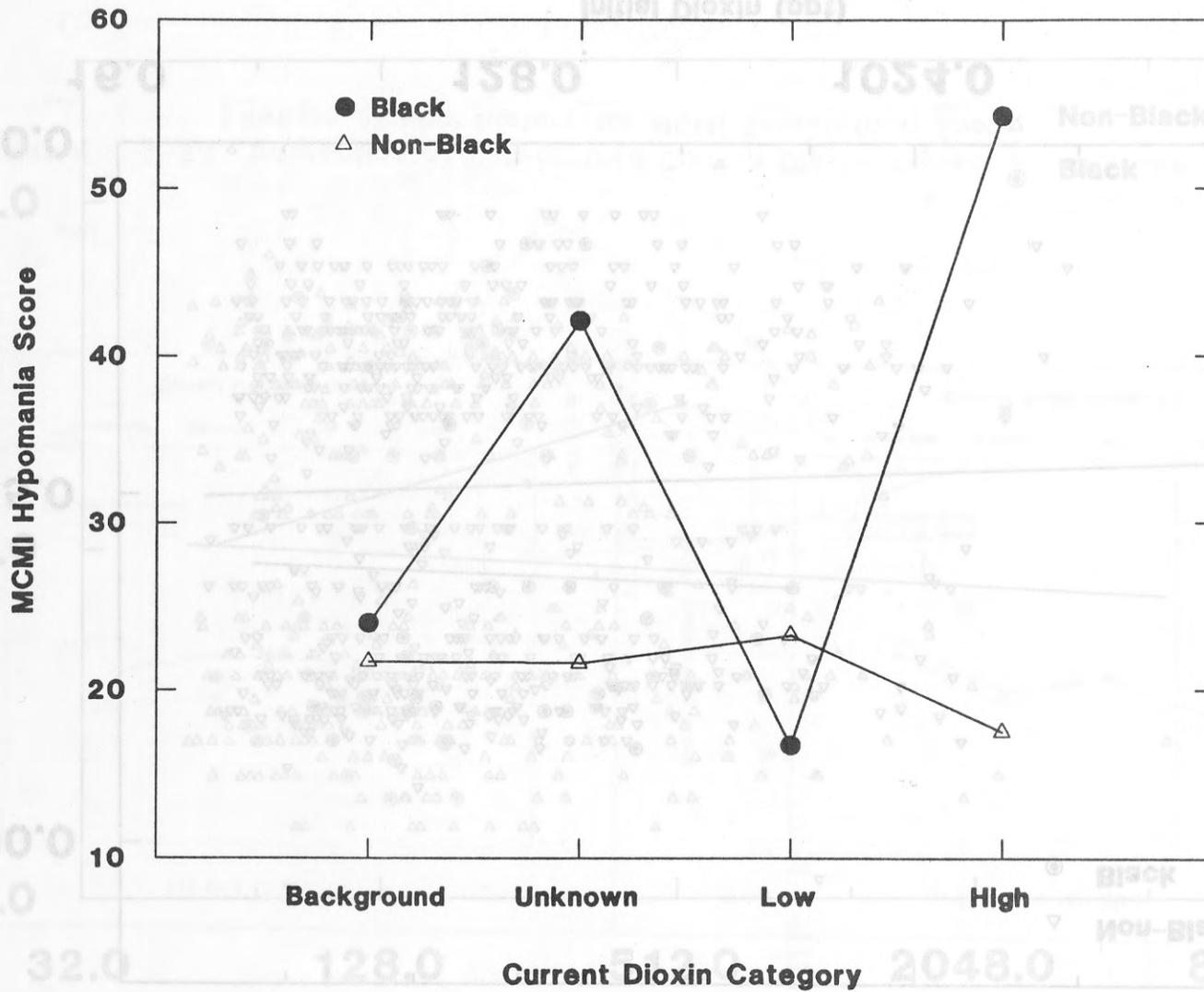
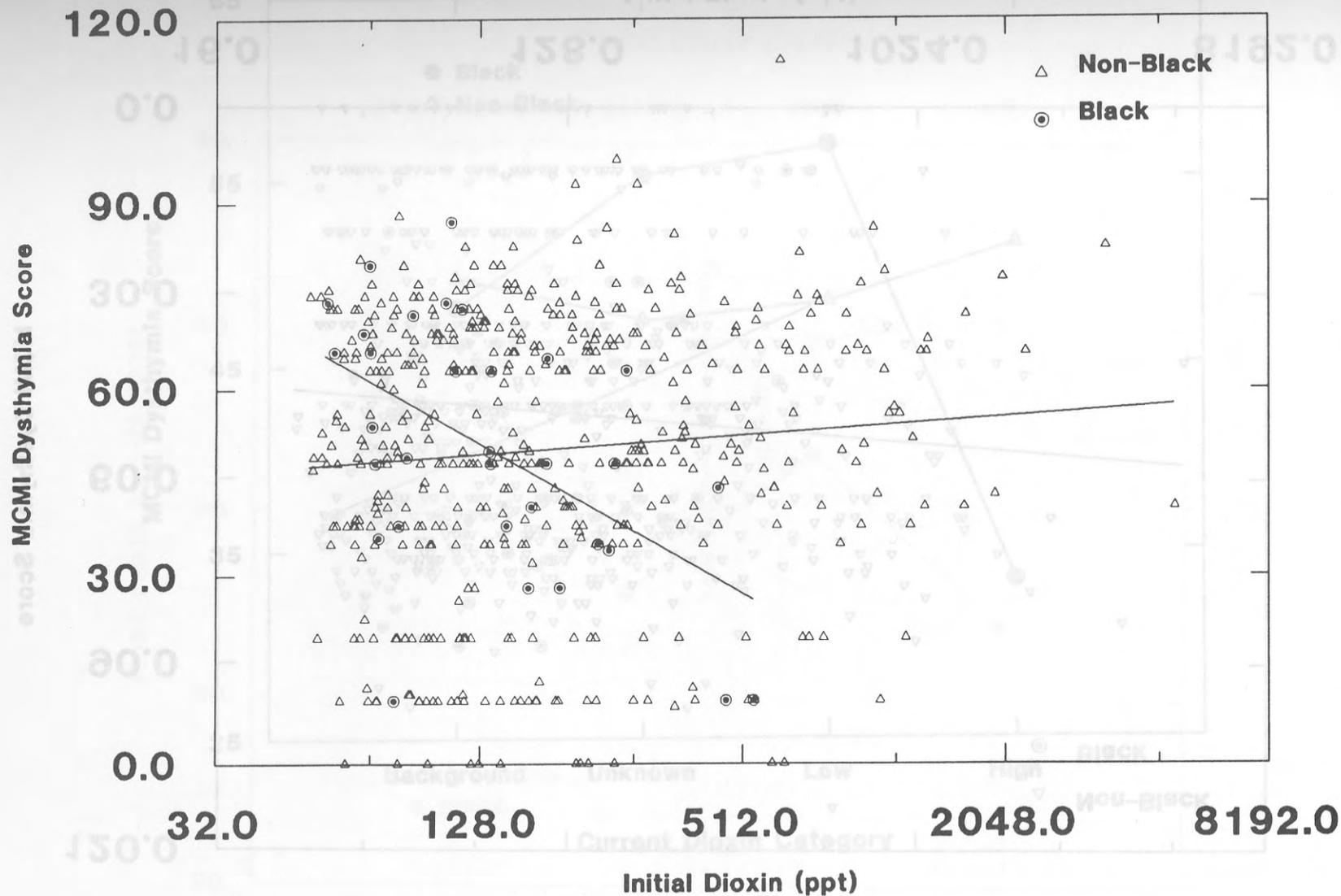


FIGURE H-2-37. Interaction of Categorized Current Dioxin and Race for MCMII Hypomania Score



**FIGURE H-2-38. Interaction of Initial Dioxin and Race for MCM1 Dysthymia Score (Ranch Hands, Minimal Assumption)**

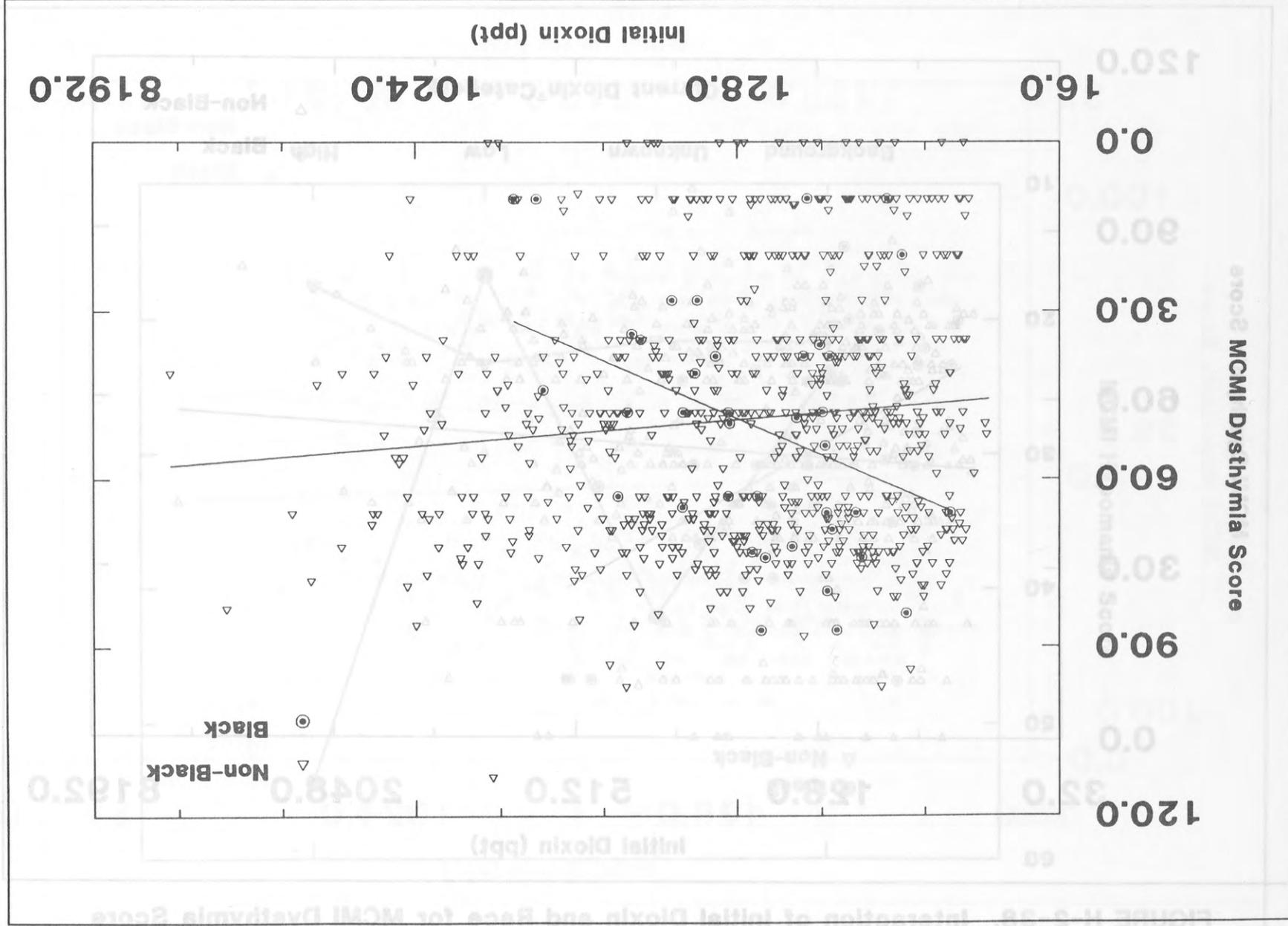


FIGURE H-2-39. Interaction of Initial Dioxin and Race for MCM1 Dysthymia Score (Ranch Hands, Maximal Assumption)

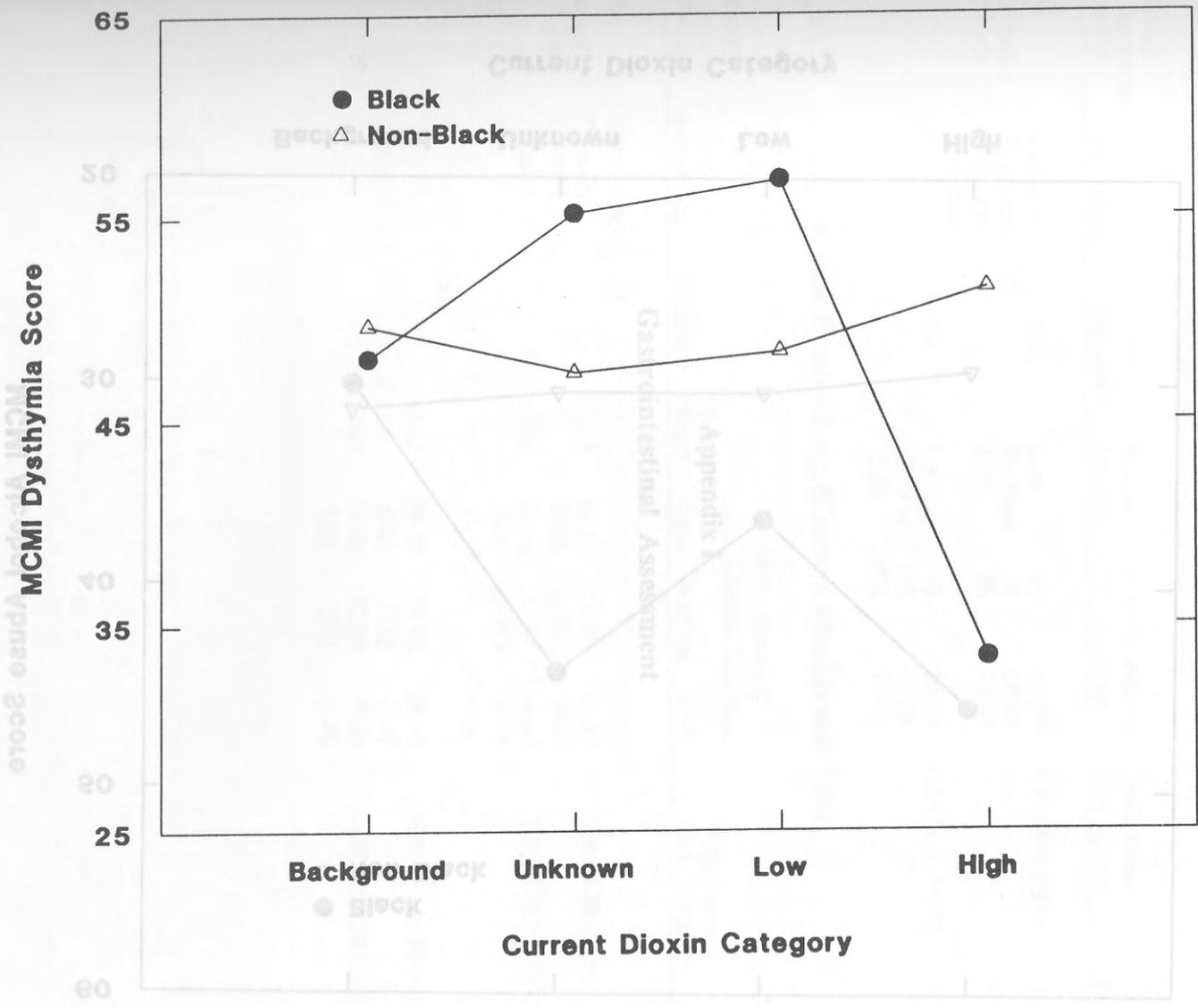


FIGURE H-2-40. Interaction of Categorized Current Dioxin and Race for MCMC Dysthymia Score

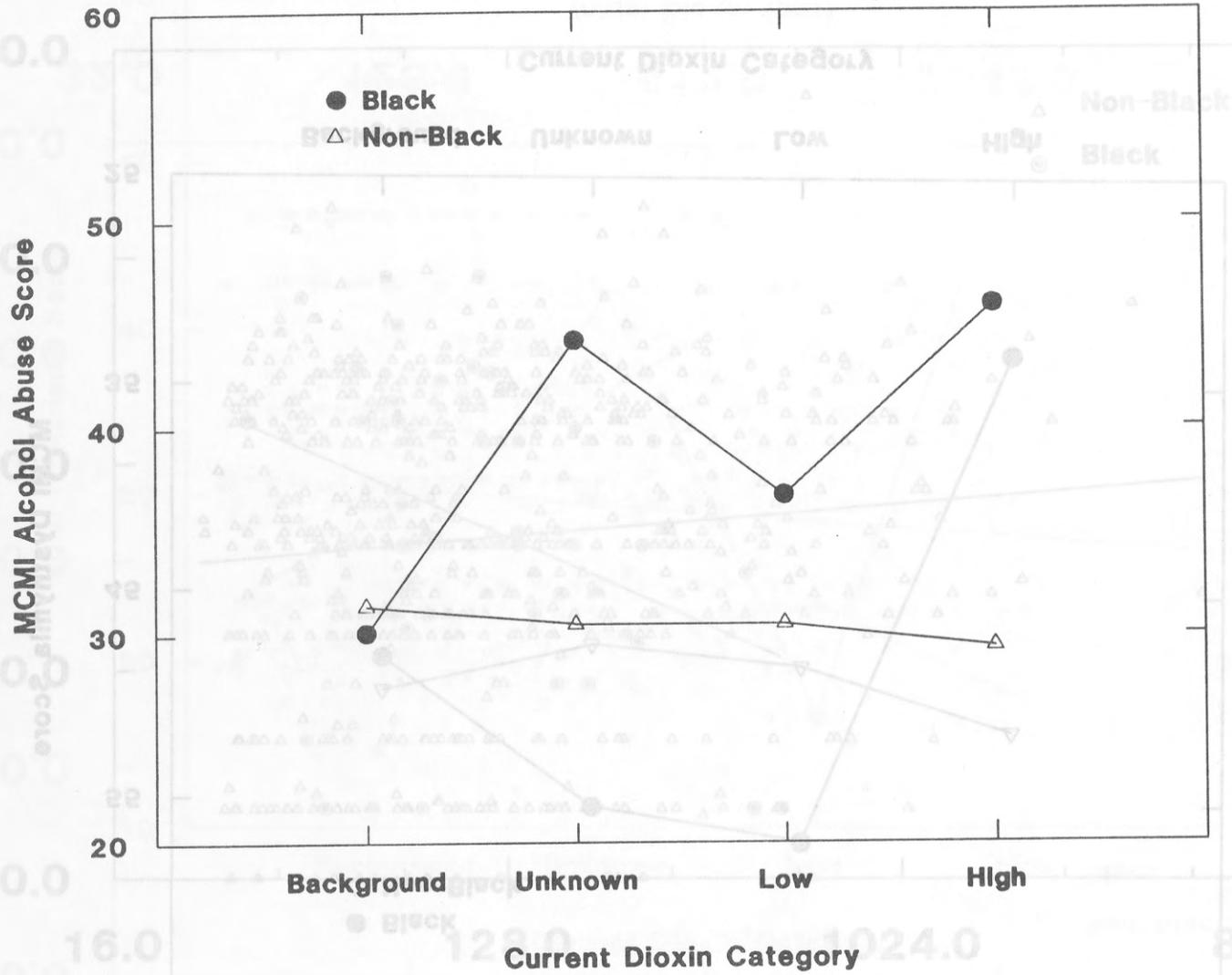


FIGURE H-2-41. Interaction of Categorized Current Dioxin and Race for MCMC Alcohol Abuse Score

## Appendix I

### Gastrointestinal Assessment

≤11.6

24.51  
(82)

24.88  
(153)

24.21  
(60)

**TABLE I-1.**

**Summary of Dioxin-by-Covariate Interactions for Gastrointestinal Variables**

<b>Ranch Hands - Log<sub>2</sub> (Initial Dioxin)</b>							
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value
AST <sup>a</sup> (Minimal-- 10-12 [c])	Initial-by- Degreasing Chemical Exposure	No	Low	57	25.87	0.0322 (0.0207)	0.121
			Medium	80	24.89		
			High	26	28.65		
		Yes	Low	73	28.29	-0.0179 (0.0133)	0.180
			Medium	173	27.09		
			High	102	26.07		

<b>Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time</b>								
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Adj. Mean/(n) Current Dioxin			Adj. Slope (Std. Error)	p-Value
				Low	Medium	High		
AST <sup>a</sup> (Maximal-- 10-12 [h])	Current-by- Time-by- Current Alcohol Use	≤1	≤18.6	24.51 (82)	24.08 (153)	24.21 (68)	-0.0053 (0.0139)	0.225 <sup>b</sup> 0.705 <sup>c</sup>
			>18.6	23.42 (63)	26.01 (139)	26.03 (84)	0.0168 (0.0125)	0.179 <sup>c</sup>
			≤18.6	26.17 (22)	24.95 (35)	26.91 (12)	0.0139 (0.0304)	0.031 <sup>b</sup> 0.647 <sup>c</sup>
		>1	>18.6	27.06 (15)	32.99 (37)	25.34 (18)	-0.0722 (0.0263)	0.006 <sup>c</sup>
			Unknown	59	22.78	U vs. B	2.83 --	0.062
			Low	40	19.98	L vs. B	1.00 --	0.981
	High	42	23.93	H vs. B	3.96 --	0.024		

**TABLE I-1. (Continued)**  
**Summary of Dioxin-by-Covariate Interactions for**  
**Gastrointestinal Variables**

<b>Ranch Hands - Log<sub>2</sub> (Initial Dioxin)</b>							
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Percent Abnormal High	Adj. Relative Risk (95% C.I.) <sup>d</sup>	p-Value
AST (Minimal-- 10-13 [c])	Initial-by- Race	Black	Low	12	25.0	--	0.010
			Medium	14	0.0		
			High	3	0.0		
	Initial-by- Degreasing Chemical Exposure	Non-Black No	Low	55	1.8	1.97 (0.95,4.09)	0.069
			Medium	77	0.0		
			High	27	11.1		
	Non-Black Yes	Low	63	7.9	0.82 (0.54,1.23)	0.340	
		Medium	164	5.5			
		High	99	4.0			
AST (Maximal-- 10-13 [d])	Initial-by- Degreasing Chemical Exposure	No	Low	85	1.2	1.60 (0.94,2.72)	0.086
			Medium	137	1.5		
			High	44	6.8		
		Yes	Low	98	6.1	0.85 (0.64,1.13)	0.258
			Medium	228	8.3		
			High	140	3.6		

<b>Ranch Hands - Log<sub>2</sub> (Initial Dioxin)</b>							
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value
ALT <sup>a</sup> (Maximal-- 10-14 [d])	Initial-by- Age	Born ≥1942	Low	70	18.29	0.0647 (0.0180)	<0.001
			Medium	124	21.45		
			High	116	23.61		
		Born <1942	Low	113	18.14	0.0091 (0.0198)	0.646
			Medium	241	20.24		
			High	68	18.64		

**TABLE I-1. (Continued)**

**Summary of Dioxin-by-Covariate Interactions for Gastrointestinal Variables**

**Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time**

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Adj. Mean/(n) Current Dioxin			Adj. Slope (Std. Error)	p-Value
				Low	Medium	High		
ALT <sup>a</sup> (Maximal-- 10-14 [h])	Current-by- Time-by- Current	≤1	≤18.6	17.73 (82)	18.68 (153)	19.85 (68)	0.0338 (0.0225)	0.388 <sup>b</sup> 0.134 <sup>c</sup>
			>18.6	16.45 (63)	20.48 (139)	21.86 (85)	0.0593 (0.0202)	0.003 <sup>c</sup>
	Alcohol Use	>1	≤18.6	23.22 (23)	22.96 (35)	26.30 (13)	0.0552 (0.0487)	0.068 <sup>b</sup> 0.257 <sup>c</sup>
			>18.6	22.87 (15)	28.81 (37)	23.12 (19)	-0.0603 (0.0408)	0.140 <sup>c</sup>

**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.) <sup>e</sup>	p-Value <sup>f</sup>
ALT <sup>a</sup> (10-14 [j])	Categorized Current Dioxin-by- Lifetime Alcohol History	0	Background	58	21.11	All		0.434
			Unknown	28	20.64	U vs. B	-0.47 --	0.834
			Low	17	18.37	L vs. B	-2.74 --	0.285
		High	30	23.19	H vs. B	2.08 --	0.376	
		>0-40	Background	530	20.28	All		0.002
			Unknown	251	18.13	U vs. B	-2.15 --	0.002
	Low		134	21.30	L vs. B	1.02 --	0.280	
	High		110	21.07	H vs. B	0.79 --	0.443	
	>40		Background	189	19.95	All		0.057
			Unknown	59	22.78	U vs. B	2.83 --	0.062
		Low	40	19.98	L vs. B	0.03 --	0.981	
	High	42	23.93	H vs. B	3.98 --	0.024		

**TABLE I-1. (Continued)**

**Summary of Dioxin-by-Covariate Interactions for  
Gastrointestinal Variables**

<b>Ranch Hands - Log<sub>2</sub> (Initial Dioxin)</b>							
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Percent Abnormal High	Adj. Relative Risk (95% C.I.) <sup>d</sup>	p-Value
ALT (Minimal-- 10-15 [c])	Initial-by- Degreasing Chemical Exposure	No	Low	57	8.8	1.62 (1.11,2.38)	0.013
			Medium	80	6.3		
			High	27	33.3		
		Yes	Low	73	15.1	0.90 (0.70,1.17)	0.433
			Medium	175	16.0		
			High	102	11.8		
ALT (Maximal-- 10-15 [d])	Initial-by- Current Alcohol Use	≤1	Low	144	6.3	1.28 (1.07,1.54)	0.007
			Medium	291	10.3		
			High	155	14.8		
		>1-4	Low	35	14.3	0.95 (0.65,1.37)	0.774
			Medium	67	26.9		
			High	21	14.3		
		>4	Low	4	25.0	0.67 (0.28,1.60)	0.371
			Medium	7	14.3		
			High	8	12.5		

**TABLE I-1. (Continued)**

**Summary of Dioxin-by-Covariate Interactions for Gastrointestinal Variables**

<b>Ranch Hands - Log<sub>2</sub> (Initial Dioxin)</b>							
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Percent Abnormal High	Adj. Relative Risk (95% C.I.) <sup>d</sup>	p-Value
GGT (Minimal-- 10-17 [c])	Initial-by- Race	Black	Low	12	25.0	--	0.055
			Medium	14	0.0		
			High	3	0.0		
	Initial-by- Degreasing Chemical Exposure	Non-Black No	Low	55	7.3	1.65 (1.13,2.42)	0.010
			Medium	77	10.4		
			High	27	25.9		
	Non-Black Yes	Low	63	9.5	0.85 (0.61,1.18)	0.336	
		Medium	164	10.4			
		High	99	6.1			
GGT (Maximal-- 10-17 [d])	Initial-by- Degreasing Chemical Exposure	No	Low	85	3.5	1.76 (1.30,2.39)	<0.001
			Medium	137	8.0		
			High	44	22.7		
		Yes	Low	98	6.1	1.01 (0.79,1.29)	0.930
			Medium	228	10.5		
			High	140	5.7		

**Ranch Hands and Comparisons by Current Dioxin Category**

Variable/ (Table Ref.)	Interaction	Stratum	Current Dioxin Category	n	Percent Abnormal High	Contrast	Adj. Relative Risk (95% C.I.)	p-Value
GGT (10-17 [j])	Categorized Current Dioxin-by- Degreasing Chemical Exposure	No	Background	295	6.1	All		0.002
			Unknown	166	4.8	U vs. B	0.93 (0.39,2.23)	0.876
			Low	61	8.2	L vs. B	1.51 (0.53,4.30)	0.444
			High	41	24.4	H vs. B	5.89 (2.43,14.29)	<0.001
		Yes	Background	482	6.0	All		0.305
			Unknown	172	6.4	U vs. B	0.98 (0.47,2.05)	0.968
			Low	130	10.8	L vs. B	1.93 (0.98,3.82)	0.058
			High	141	6.4	H vs. B	1.09 (0.50,2.39)	0.822

TABLE I-1. (Continued)  
**Summary of Dioxin-by-Covariate Interactions for  
 Gastrointestinal Variables**

**Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time**

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Adj. Mean/(n) Current Dioxin			Adj. Slope (Std. Error)	p-Value	
				Low	Medium	High			
Alkaline Phosphatase <sup>a</sup> (Minimal-- 10-18 [g])	Current-by- Time-by- Lifetime	0	≤18.6	95.15 (30)	92.20 (76)	93.48 (33)	-0.0154 (0.0175)	0.160 <sup>b</sup> 0.378 <sup>c</sup>	
			>18.6	94.68 (28)	91.74 (78)	96.28 (55)	0.0154 (0.0133)	0.249 <sup>c</sup>	
	Wine History	>0	≤18.6	86.19 (42)	92.76 (50)	90.22 (19)	0.0211 (0.0214)	0.141 <sup>b</sup> 0.325 <sup>c</sup>	
			>18.6	94.98 (30)	91.37 (50)	88.75 (22)	-0.0221 (0.0202)	0.276 <sup>c</sup>	
			Black	≤18.6	80.67 (4)	81.52 (10)	107.82 (2)	0.0505 (0.1082)	0.205 <sup>b</sup> 0.644 <sup>c</sup>
				>18.6	105.61 (1)	105.77 (12)	81.26 (6)	-0.1099 (0.0654)	0.104 <sup>c</sup>
Alkaline Phosphatase <sup>a</sup> (Maximal-- 10-18 [h])	Current-by- Time-by- Race	Non-Black	≤18.6	91.21 (48)	96.03 (105)	94.34 (57)	0.0039 (0.0124)	0.486 <sup>b</sup> 0.752 <sup>c</sup>	
			>18.6	89.16 (40)	95.32 (108)	97.08 (77)	0.0150 (0.0103)	0.147 <sup>c</sup>	
	Current-by- Time-by- Current Wine Use	0	≤18.6	84.79 (52)	90.26 (74)	89.11 (22)	0.0261 (0.0164)	0.288 <sup>b</sup> 0.112 <sup>c</sup>	
			>18.6	88.02 (37)	91.13 (56)	88.07 (20)	0.0015 (0.0168)	0.927 <sup>c</sup>	

**TABLE I-1. (Continued)**

**Summary of Dioxin-by-Covariate Interactions for  
Gastrointestinal Variables**

<b>Ranch Hands - Log<sub>2</sub> (Initial Dioxin)</b>							
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value
D-Glucaric Acid <sup>g</sup> (Minimal-- 10-20 [c])	Initial-by- Race	Black	Low	12	26.89	-0.6782 (0.3606)	0.061
			Medium	15	13.82		
			High	3	8.67		
	Non-Black	Low	112	15.08	0.0665 (0.0696)	0.340	
		Medium	237	14.85			
		High	124	15.38			
Total Bilirubin <sup>a</sup> (Maximal-- 10-22 [d])	Initial-by- Race	Black	Low	4	1.212	-0.1084 (0.0502)	0.031
			Medium	25	0.803		
			High	7	0.732		
	Non-Black	Low	180	0.781	0.0012 (0.0081)	0.885	
		Medium	343	0.775			
		High	178	0.786			

**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.) <sup>e</sup>	p-Value <sup>f</sup>	
Direct Bilirubin <sup>h</sup> (10-24 [j])	Categorized Current Dioxin-by- Race	Black	Background	46	0.119	All		0.008	
			Unknown	12	0.261	U vs. B	0.142 --	<0.001	
			Low	10	0.162	L vs. B	0.043 --	0.271	
			High	8	0.175	H vs. B	0.056 --	0.199	
		Non- Black	Background	733	0.153	All		0.061	
			Unknown	329	0.145	U vs. B	-0.008 --	0.279	
			Low	183	0.159	L vs. B	0.006 --	0.555	
			High	178	0.175	H vs. B	0.022 --	0.033	

TABLE I-1. (Continued)

Summary of Dioxin-by-Covariate Interactions for Gastrointestinal Variables

Ranch Hands - Log <sub>2</sub> (Initial Dioxin)							
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Percent Abnormal High	Adj. Relative Risk (95% C.I.) <sup>d</sup>	p-Value
Direct Bilirubin (Minimal-- 10-25 [c])	Initial-by- Industrial Chemical Exposure	No	Low	65	3.1	1.30 (0.73,2.30)	0.371
			Medium	107	4.7		
			High	37	2.7		
		Yes	Low	65	12.3	0.42 (0.21,0.86)	0.018
			Medium	150	2.7		
			High	93	1.1		
Direct Bilirubin (Maximal-- 10-25 [d])	Initial-by- Industrial Chemical Exposure	No	Low	97	2.1	1.43 (0.93,2.21)	0.107
			Medium	172	2.9		
			High	63	4.8		
		Yes	Low	87	2.3	0.68 (0.44,1.05)	0.081
			Medium	196	6.1		
			High	122	1.6		

Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Percent Abnormal High/(n) Current Dioxin			Adj. Relative Risk (95% C.I.) <sup>d</sup>	p-Value		
				Low	Medium	High				
Direct Bilirubin (Minimal-- 10-25 [g])	Current-by- Time-by- Degreasing Chemical Exposure	No	≤18.6	10.7 (28)	5.7 (35)	0.0 (9)	0.44 (0.09,2.10)	0.302 <sup>j</sup>		
			>18.6	3.3 (30)	11.1 (45)	5.6 (18)			1.08 (0.58,2.03)	0.802 <sup>j</sup>
			Yes	≤18.6	4.5 (44)	3.3 (91)				
		>18.6	7.1 (28)	1.2 (86)	0.0 (59)	0.15 (0.01,1.60)	0.116 <sup>j</sup>			

TABLE I-1. (Continued)

**TABLE I-1. (Continued)**  
**Summary of Dioxin-by-Covariate Interactions for**  
**Gastrointestinal Variables**

**Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time**

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Adj. Mean/(n) Current Dioxin			Adj. Slope (Std. Error)	p-Value
				Low	Medium	High		
Cholesterol <sup>a</sup> (Maximal-- 10-28 [h])	Current-by- Time-by- Lifetime Alcohol History	0	≤18.6	199.1 (8)	212.6 (18)	213.3 (9)	0.0225 (0.0252)	0.952 <sup>b</sup> 0.371 <sup>c</sup>
			>18.6	210.6 (6)	197.0 (11)	218.5 (21)	0.0207 (0.0186)	0.267 <sup>c</sup>
		>0-40	≤18.6	210.2 (78)	214.1 (144)	221.2 (55)	0.0090 (0.0092)	0.916 <sup>b</sup> 0.326 <sup>c</sup>
			>18.6	214.4 (59)	210.5 (113)	216.7 (55)	0.0104 (0.0088)	0.242 <sup>c</sup>
		>40	≤18.6	206.8 (18)	209.1 (26)	197.5 (16)	-0.0059 (0.0176)	0.152 <sup>b</sup> 0.738 <sup>c</sup>
			>18.6	204.8 (13)	205.9 (52)	222.5 (26)	0.0262 (0.0138)	0.059 <sup>c</sup>

**Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time**

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Percent Abnormal High/(n) Current Dioxin			Adj. Relative Risk (95% C.I.) <sup>d</sup>	p-Value
				Low	Medium	High		
Cholesterol (Minimal-- 10-29 [g])	Current-by- Time-by- Industrial Chemical Exposure	No	≤18.6	6.3 (32)	8.2 (49)	23.1 (13)	1.73 (0.90,3.33)	0.060 <sup>i</sup> 0.102 <sup>j</sup>
			>18.6	13.9 (36)	12.5 (56)	4.3 (23)	0.75 (0.40,1.40)	0.369 <sup>j</sup>
		Yes	≤18.6	22.5 (40)	20.8 (77)	5.0 (40)	0.67 (0.42,1.06)	0.030 <sup>i</sup> 0.083 <sup>j</sup>
			>18.6	18.2 (22)	13.3 (75)	14.8 (54)	1.22 (0.86,1.73)	0.261 <sup>j</sup>

**TABLE I-1. (Continued)**

**Summary of Dioxin-by-Covariate Interactions for  
Gastrointestinal Variables**

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin)**

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value
HDL <sup>a</sup> (Maximal-- 10-30 [d])	Initial-by- Degreasing Chemical Exposure	No	Low	84	51.55	-0.0512 (0.0122)	<0.001
			Medium	137	45.34		
			High	43	44.65		
		Yes	Low	98	45.69	-0.0105 (0.0082)	0.200
			Medium	228	44.80		
			High	138	44.12		

**Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time**

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Adj. Mean/(n) Current Dioxin			Adj. Slope (Std. Error)	p-Value
				Low	Medium	High		
HDL <sup>a</sup> (Minimal-- 10-30 [g])	Current-by- Time-by- Industrial Chemical Exposure	No	≤18.6	45.84 (32)	45.15 (49)	42.79 (13)	-0.0330 (0.0253)	0.115 <sup>b</sup>
			>18.6	41.88 (36)	42.11 (55)	44.91 (23)		0.193 <sup>c</sup>
								0.391 <sup>c</sup>
		Yes	≤18.6	46.45 (40)	45.25 (77)	49.24 (39)	0.0087 (0.0185)	0.110 <sup>b</sup>
			>18.6	52.07 (22)	44.99 (74)	45.79 (54)		0.639 <sup>c</sup>
								0.065 <sup>c</sup>

**TABLE I-1. (Continued)**

**Summary of Dioxin-by-Covariate Interactions for Gastrointestinal 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.) <sup>e</sup>	p-Value <sup>f</sup>		
HDL <sup>a</sup> (10-30 [j])	Categorized Current Dioxin-by- Lifetime Alcohol History	0	Background	58	43.77	All		0.657		
			Unknown	28	45.01	U vs. B	1.24 --	0.609		
			Low	17	46.00	L vs. B	2.23 --	0.446		
					High	30	46.62	H vs. B	2.85 --	0.236
		>0-40	Background	530	46.01	All		<0.001		
			Unknown	251	50.16	U vs. B	4.15 --	<0.001		
			Low	134	45.24	L vs. B	-0.77 --	0.455		
			High	110	44.06	H vs. B	-1.95 --	0.083		
			>40	Background	189	46.77	All		0.315	
				Unknown	59	46.65	U vs. B	-0.12 --	0.938	
		Low		40	43.78	L vs. B	-2.99 --	0.109		
			High	42	44.63	H vs. B	-2.14 --	0.245		

**Ranch Hands and Comparisons by Current Dioxin Category**

Variable/ (Table Ref.)	Interaction	Stratum	Current Dioxin Category	n	Percent Abnormal Low	Contrast	Adj. Relative Risk (95% C.I.)	p-Value
HDL (10-31 [j])	Categorized Current Dioxin-by- Degreasing Chemical Exposure	No	Background	296	2.0	All		0.058
			Unknown	167	4.8	U vs. B	2.23 (0.76,6.55)	0.146
			Low	61	0.0	L vs. B	--	--
			High	42	7.1	H vs. B	3.43 (0.82,14.37)	0.091
		Yes	Background	483	4.6	All		0.429
			Unknown	172	2.3	U vs. B	0.51 (0.17,1.52)	0.228
			Low	130	6.2	L vs. B	1.35 (0.39,4.64)	0.630
			High	143	4.9	H vs. B	1.07 (0.45,2.57)	0.874

**TABLE I-1. (Continued)**

**Summary of Dioxin-by-Covariate Interactions for  
Gastrointestinal Variables**

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin)**

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value
Cholesterol- HDL Ratio <sup>a</sup> (Minimal-- 10-32 [d])	Initial-by- Degreasing Chemical Exposure	No	Low	85	3.98	0.0633 (0.0133)	<0.001
			Medium	137	4.63		
			High	44	4.87		
	Yes	Low	98	4.64	0.0221 (0.0091)	0.015	
		Medium	228	4.64			
		High	140	4.87			

**Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time**

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Adj. Mean/(n) Current Dioxin			Adj. Slope (Std. Error)	p-Value		
				Low	Medium	High				
Cholesterol- HDL Ratio <sup>a</sup> (Minimal-- 10-32 [g])	Current-by- Time-by- Industrial Chemical Exposure	No	≤18.6	4.56 (32)	4.64 (49)	5.25 (13)	0.0482 (0.0275)	0.217 <sup>b</sup> 0.080 <sup>c</sup>		
			>18.6	4.79 (36)	5.02 (55)	4.74 (23)			0.0062 (0.0206)	0.762 <sup>c</sup>
			Yes	≤18.6	4.49 (40)	4.72 (77)				
		>18.6	3.86 (22)	4.61 (74)	4.70 (54)	0.0576 (0.0172)	<0.001 <sup>c</sup>			

**TABLE I-1. (Continued)**

**Summary of Dioxin-by-Covariate Interactions for Gastrointestinal Variables**

**Ranch Hands - Log<sub>2</sub> (Initial Dioxin)**

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Percent Abnormal		Adj. Relative Risk (95% C.I.) <sup>d</sup>	p-Value
					High	High		
Cholesterol- HDL Ratio (Maximal-- 10-33 [d])	Initial-by- Age	Born≥1942	Low	29	20.7	1.49 (1.18,1.89)	0.001	
		No	Medium	38	39.5			
			High	30	50.0			
	Initial-by- Degreasing Chemical Exposure	Born≥1942	Low	41	51.2	1.00 (0.84,1.19)	0.999	
		Yes	Medium	86	44.2			
			High	86	45.3			
		Born<1942	Low	56	26.8	1.89 (1.45,2.46)	<0.001	
		No	Medium	99	52.5			
			High	14	71.4			
		Born<1942	Low	57	45.6	1.27 (1.05,1.53)	0.012	
		Yes	Medium	142	43.7			
			High	54	53.7			

**Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time**

Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Time (Yrs.)	Percent Abnormal High/(n) Current Dioxin			Adj. Relative Risk (95% C.I.) <sup>d</sup>	p-Value		
				Low	Medium	High				
Cholesterol- HDL Ratio (Minimal-- 10-33 [g])	Current-by- Time-by- Industrial Chemical Exposure	No	≤18.6	43.8 (32)	36.7 (49)	69.2 (13)	1.46 (0.94,2.27)	0.089 <sup>j</sup>		
			>18.6	50.0 (36)	61.8 (55)	52.2 (23)			1.23 (0.88,1.73)	0.230 <sup>j</sup>
		Yes	≤18.6	50.0 (40)	50.6 (77)	28.2 (39)	0.90 (0.66,1.24)	0.008 <sup>i</sup> 0.532 <sup>j</sup>		
			>18.6	22.7 (22)	51.4 (74)	57.4 (54)				

**TABLE I-1. (Continued)**

**Summary of Dioxin-by-Covariate Interactions for  
Gastrointestinal 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.) <sup>e</sup>	p-Value <sup>f</sup>	
Triglycerides <sup>a</sup> (10-34 [j])	Categorized Current Dioxin-by- Current Alcohol Use	≤1	Background	609	106.2	All		<0.001	
			Unknown	273	92.4	U vs. B	-13.8 --	0.002	
			Low	154	122.2	L vs. B	16.0 --	0.014	
			High	152	126.7	H vs. B	20.5 --	0.002	
		>1-4	Background	140	103.2	All		0.076	
				Unknown	58	95.6	U vs. B	-7.6 --	0.435
				Low	34	133.8	L vs. B	30.6 --	0.030
				High	23	96.6	H vs. B	-6.6 --	0.641
		≥4	Background	28	72.7	All		0.129	
				Unknown	7	85.3	U vs. B	12.6 --	0.552
				Low	3	103.0	L vs. B	30.3 --	0.362
				High	7	134.4	H vs. B	61.7 --	0.021

**Ranch Hands and Comparisons by Current Dioxin Category**

Variable/ (Table Ref.)	Interaction	Stratum	Current Dioxin Category	n	Percent Abnormal High	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	
Triglycerides (10-35 [j])	Categorized Current Dioxin-by- Current Alcohol Use	≤1	Background	611	5.2	All		<0.001	
			Unknown	273	2.2	U vs. B	0.39 (0.16,0.94)	0.035	
			Low	154	8.4	L vs. B	1.63 (0.83,3.19)	0.155	
			High	153	13.7	H vs. B	3.08 (1.70,5.58)	<0.001	
		>1-4	Background	140	7.1	All		0.225	
				Unknown	59	6.8	U vs. B	0.91 (0.27,3.02)	0.872
				Low	34	11.8	L vs. B	1.85 (0.54,6.34)	0.328
				High	24	0.0	H vs. B	--	--
		≥4	Background	28	0.0	All		0.051	
				Unknown	7	14.3	U vs. B	--	--
				Low	3	0.0	L vs. B	--	--
				High	8	12.5	H vs. B	--	--

TABLE I-1. (Continued)

Summary of Dioxin-by-Covariate Interactions for Gastrointestinal Variables

Ranch Hands - Log <sub>2</sub> (Initial Dioxin)							
Variable/ (Assumption-- Table Ref.)	Interaction	Stratum	Initial Dioxin	n	Adj. Mean	Adj. Slope (Std. Error)	p-Value
Creatine Kinase <sup>a</sup> (Minimal-- 10-36 [c])	Initial-by- Age	Born ≥1942	Low	43	132.9	0.0457 (0.0233)	0.051
			Medium	109	137.3		
			High	82	159.5		
	Born <1942	Low	87	143.8	-0.0556 (0.0245)	0.024	
		Medium	146	137.6			
		High	47	119.0			
Creatine Kinase <sup>a</sup> (Maximal-- 10-36 [d])	Initial-by- Age	Born ≥1942	Low	71	155.4	0.0233 (0.0165)	0.158
			Medium	124	140.8		
			High	117	165.4		
	Born <1942	Low	113	148.2	-0.0371 (0.0179)	0.039	
		Medium	244	145.3			
		High	68	130.0			

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.) <sup>e</sup>	p-Value <sup>f</sup>
Creatine Kinase <sup>a</sup> (10-36 [j])	Categorized Current Dioxin-by- Race	Black	Background	46	247.4	All		0.031
			Unknown	12	173.1	U vs. B	-74.3 --	0.023
			Low	10	176.3	L vs. B	-71.1 --	0.045
			High	8	182.4	H vs. B	-65.0 --	0.101
		Non- Black	Background	733	105.2	All		0.613
			Unknown	329	105.4	U vs. B	0.2 --	0.942
			Low	183	105.4	L vs. B	0.2 --	0.951
			High	178	111.0	H vs. B	5.8 --	0.189

**TABLE I-1. (Continued)**

**Summary of Dioxin-by-Covariate Interactions for Gastrointestinal Variables**

**Ranch Hands and Comparisons by Current Dioxin Category**

Variable/ (Table Ref.)	Interaction	Stratum	Current Dioxin Category	n	Percent Abnormal High	Contrast	Adj. Relative Risk (95% C.I.)	p-Value
Creatine Kinase (10-37 [j])	Categorized Current Dioxin-by- Race	Black	Background	46	54.3	All		0.001
			Unknown	12	25.0	U vs. B	0.30 (0.07,1.36)	0.119
			Low	9	0.0	L vs. B	--	--
		Non- Black	High	8	25.0	H vs. B	0.29 (0.05,1.66)	0.165
			Background	733	4.9	All		0.664
			Unknown	327	4.6	U vs. B	0.93 (0.50,1.74)	0.832
		Low	182	4.9	L vs. B	0.95 (0.45,2.01)	0.887	
		High	177	2.8	H vs. B	0.55 (0.21,1.44)	0.224	

<sup>a</sup>Adjusted means transformed from natural logarithm scale; adjusted slope and standard error based on natural logarithm of the dependent variable versus log<sub>2</sub> dioxin.

<sup>b</sup>Test of significance for homogeneity of slopes (current dioxin continuous, time categorized).

<sup>c</sup>Test of significance for slope equal to 0 (current dioxin continuous, time categorized).

<sup>d</sup>Relative risk for a twofold increase in dioxin.

<sup>e</sup>Difference of means after transformation to original scale; confidence interval on difference of means not given because analysis was performed on natural logarithm scale.

<sup>f</sup>P-value is based on difference of means on natural logarithm scale.

<sup>g</sup>Adjusted means transformed from square root scale; adjusted slope and standard error based on square root of the dependent variable versus log<sub>2</sub> dioxin.

<sup>h</sup>Adjusted means transformed from natural logarithm (X + 0.1) scale; adjusted slope and standard error based on natural logarithm (X + 0.1) of direct bilirubin versus log<sub>2</sub> dioxin.

<sup>i</sup>Test of significance for homogeneity of relative risks (current dioxin continuous, time categorized).

<sup>j</sup>Test of significance for relative risk equal to 1 (current dioxin continuous, time categorized).

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.

**TABLE I-2.**

**Summary of Models With Adjustment for Occupation  
for Viral Hepatitis**

<b>Ranch Hands - Log<sub>2</sub> (Initial Dioxin)</b>				
Assumption/ (Table Ref.)	Adj. Relative Risk (95% C.I.) <sup>a</sup>		p-Value	Covariate Remarks
Minimal (10-3 [c]) (n=506)	1.01 (0.85,1.20)		0.912	AGE (p<0.001) RACE (p=0.052) OCC (p<0.001)
Maximal (10-3 [d]) (n=720)	1.02 (0.89,1.17)		0.777	AGE (p<0.001) RACE (p=0.034) OCC (p<0.001)

**Ranch Hands - Log<sub>2</sub> (Current Dioxin) and Time**

Assumption/ (Table Ref.)	Time (Yrs.)	Adj. Relative Risk (95% C.I.) <sup>a</sup>	p-Value	Covariate Remarks
Minimal (10-3 [g]) (n=506)	≤18.6	1.09 (0.83,1.44)	0.531 <sup>c</sup>	AGE (p<0.001) RACE (p=0.059) OCC (p<0.001)
	>18.6	0.93 (0.74,1.17)	0.522 <sup>c</sup>	
Maximal (10-3 [h]) (n=720)	≤18.6	1.07 (0.88,1.31)	0.503 <sup>c</sup>	AGE (p<0.001) RACE (p=0.036) OCC (p<0.001)
	>18.6	0.96 (0.80,1.14)	0.612 <sup>c</sup>	

**Ranch Hands and Comparisons by Current Dioxin Category**

Current Dioxin Category/ (Table Ref.)	n	Contrast	Adj. Relative Risk (95% C.I.)	p-Value	Covariate Remarks
Background	761	All Categories		0.667	AGE (p<0.001) RACE (p=0.002) OCC (p<0.001)
Unknown	335	Unknown vs. Background	1.01 (0.75,1.35)	0.963	
Low	191	Low vs. Background	0.82 (0.58,1.16)	0.251	
High	181	High vs. Background	1.03 (0.72,1.47)	0.859	
Total	1,468				

<sup>a</sup>Relative risk for a twofold increase in dioxin.

<sup>b</sup>Test of significance for homogeneity of relative risks (current dioxin continuous, time categorized).

<sup>c</sup>Test of significance for relative risk equal to 1 (current dioxin continuous, time categorized).

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

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

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

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

## APPENDIX I-1.

### Data Displays for the Gastrointestinal Assessment

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

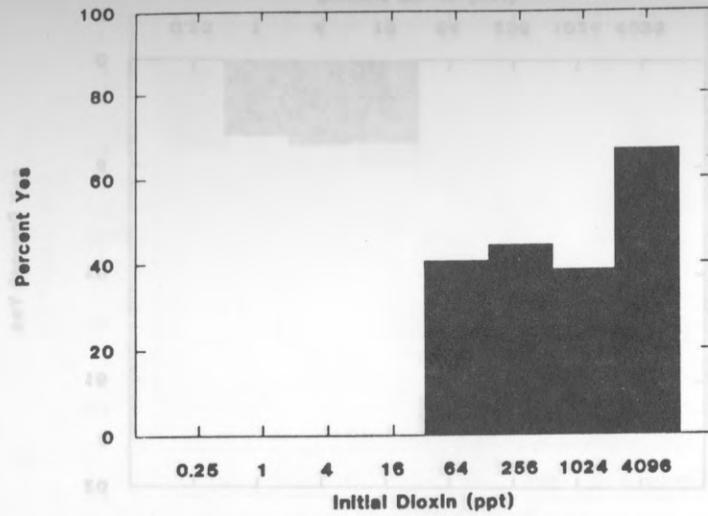
Panel	Group	Assumption	Dioxin Measure
a	Ranch Hand	Minimal	Initial
b	Ranch Hand	Maximal	Initial
c	Comparison	--	Current
d	Ranch Hand	--	Current

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 (transform of the) dependent variable and log<sub>2</sub> 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.

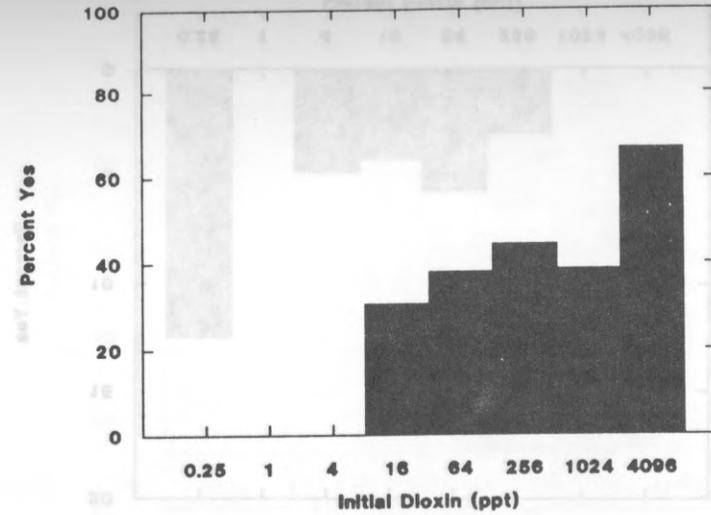
Dioxin Interval	Dioxin Scale Midpoint	Panel			
		a	b	c	d
		Sample Size			
0.0-0.5	0.25	0	0	42	8
>0.5-2.0	1	0	0	28	8
>2.0-8.0	4	0	0	681	249
>8.0-32.0	16	0	23	52	408
>32.0-128.0	64	219	417	1	158
>128.0-512.0	256	234	234	0	33
>512.0-2,048.0	1024	65	65	0	2
>2,048.0	4096	3	3	0	0

<b>Figure</b>		<b>Page</b>
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I-1-20	Total Bilirubin (Continuous) versus Dioxin.....	I-1-22
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I-1-26	Cholesterol (Continuous) versus Dioxin .....	I-1-28
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I-1-28	HDL (Continuous) versus Dioxin.....	I-1-30
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I-1-30	Cholesterol-HDL Ratio (Continuous) versus Dioxin .....	I-1-32
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I-1-32	Triglycerides (Continuous) versus Dioxin .....	I-1-34
I-1-33	Triglycerides (Discrete) versus Dioxin.....	I-1-35
I-1-34	Creatine Kinase (Continuous) versus Dioxin .....	I-1-36
I-1-35	Creatine Kinase (Discrete) versus Dioxin .....	I-1-37

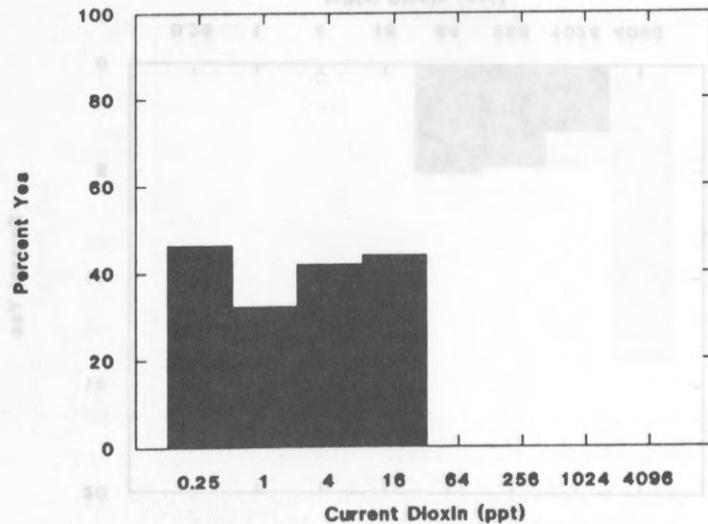
(a) Ranch Hands Minimal Assumption - Initial Dioxin



(b) Ranch Hands Maximal Assumption - Initial Dioxin



(c) All Comparisons - Current Dioxin



(d) All Ranch Hands - Current Dioxin

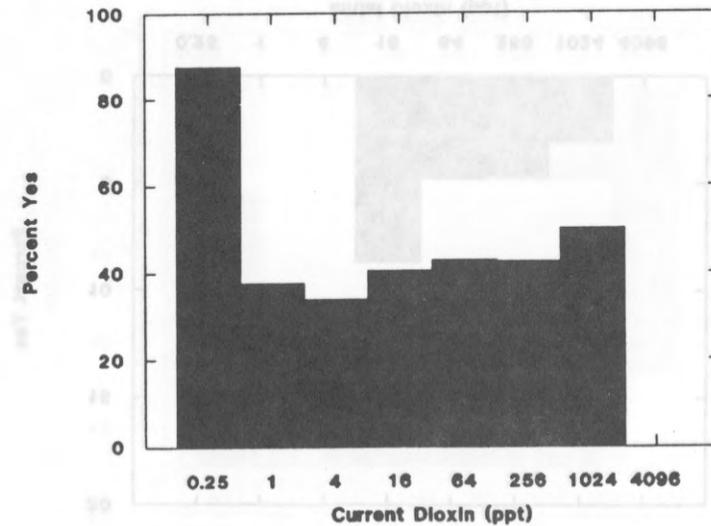


FIGURE I-1-1. Viral Hepatitis versus Dioxin

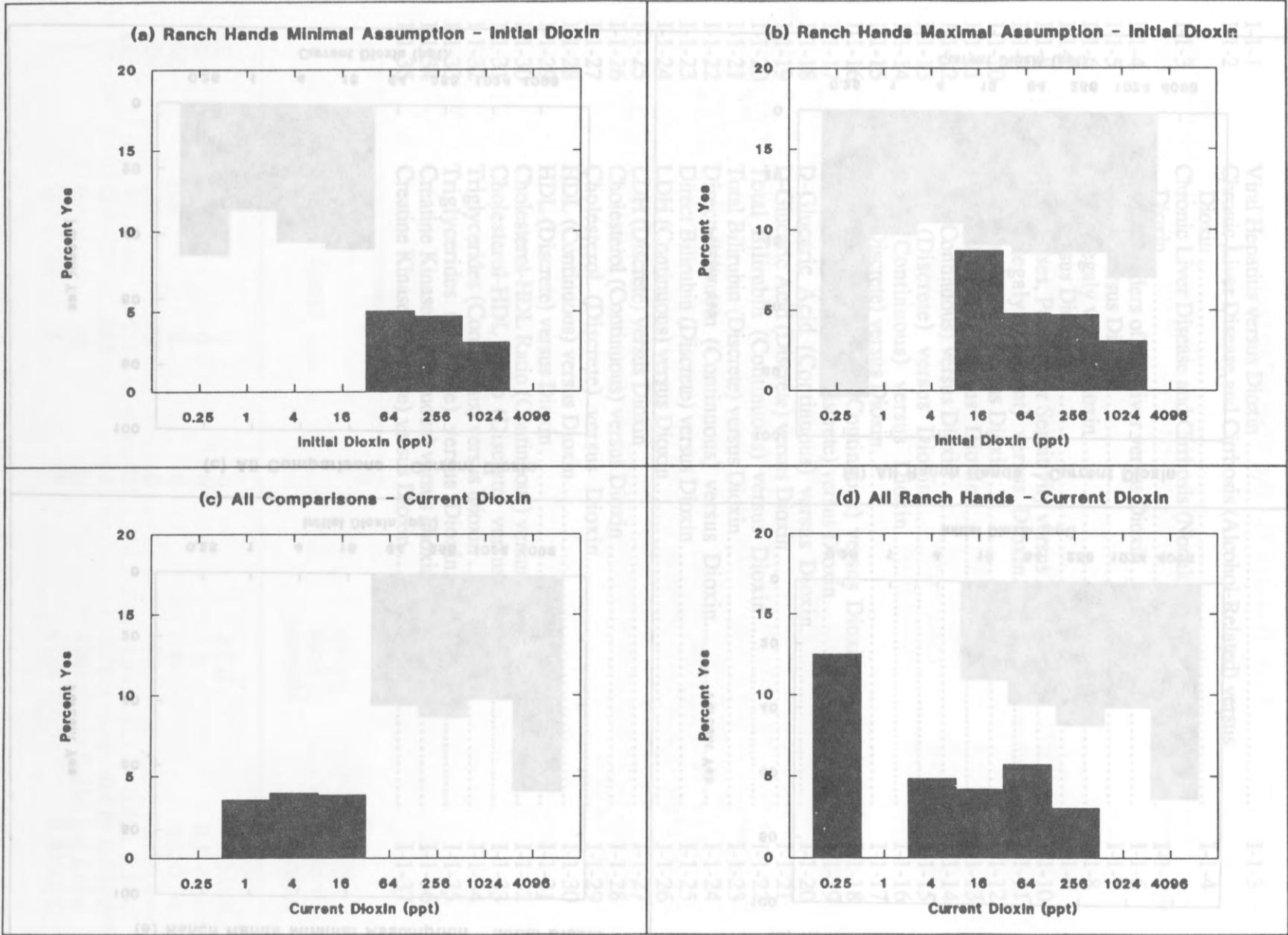
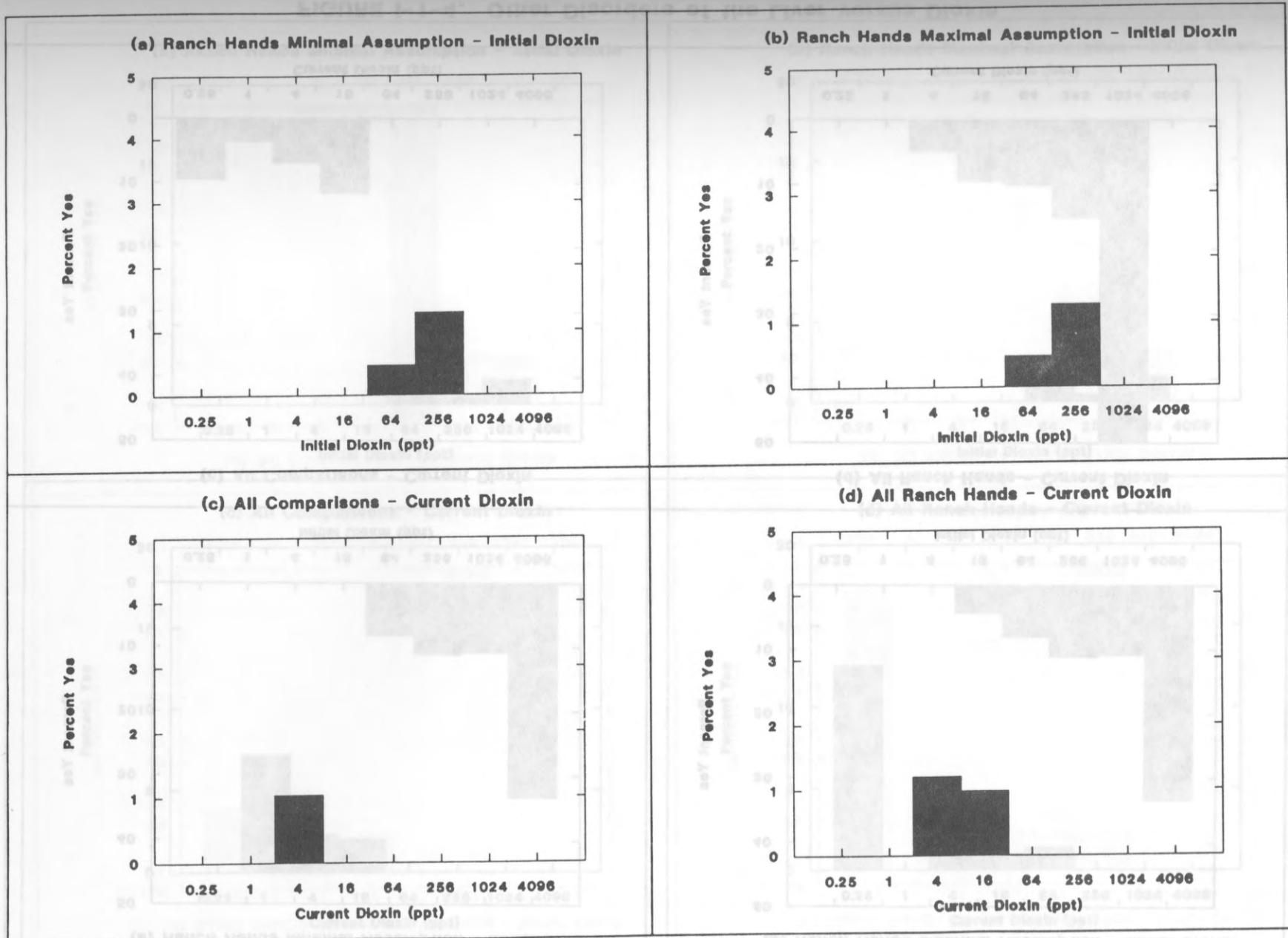


FIGURE I-1-2. Chronic Liver Disease and Cirrhosis (Alcohol-Related) versus Dioxin

I-14



**FIGURE I-1-3. Chronic Liver Disease and Cirrhosis (Nonalcohol-Related) versus Dioxin**

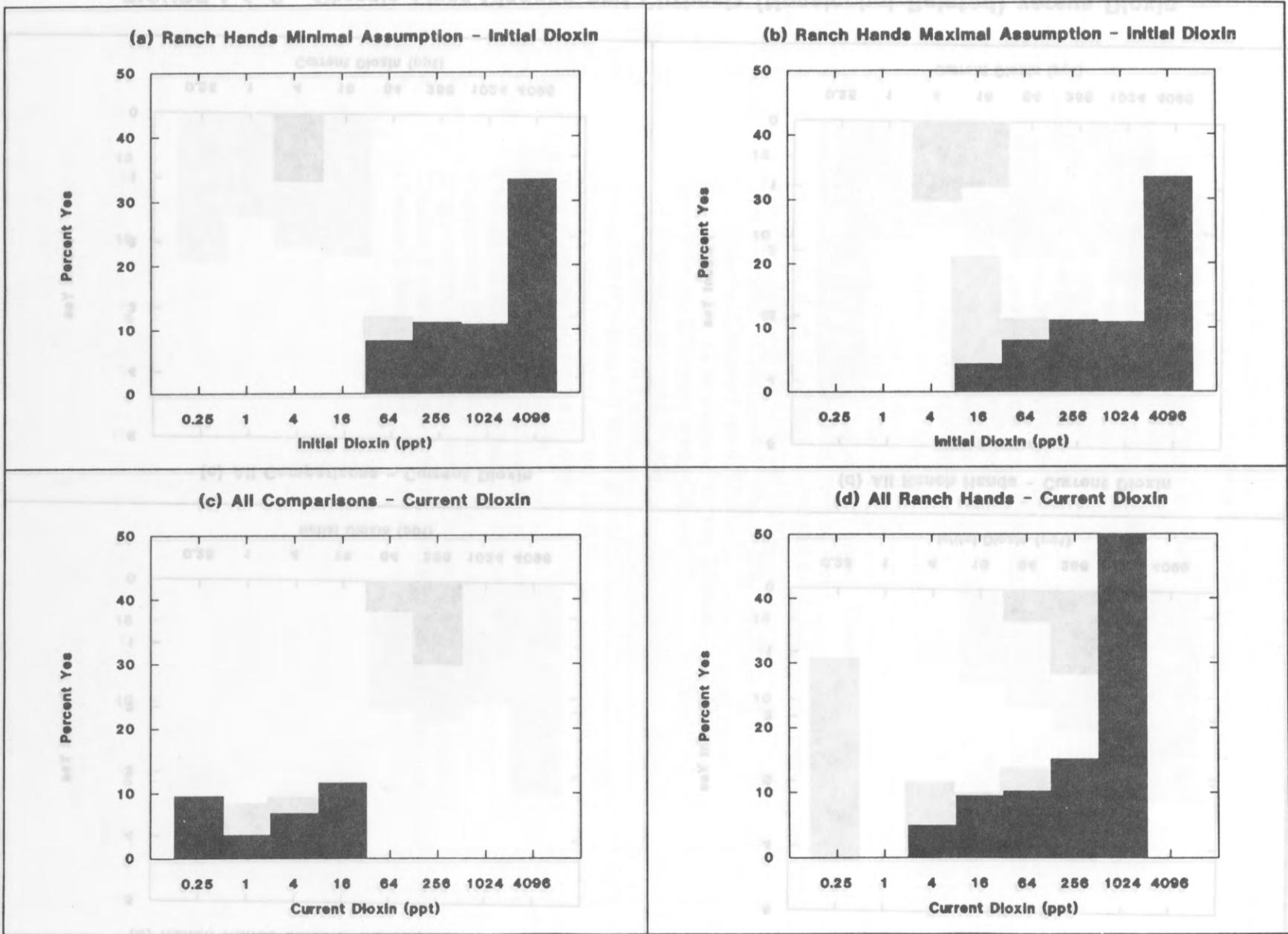


FIGURE I-1-4. Other Disorders of the Liver versus Dioxin

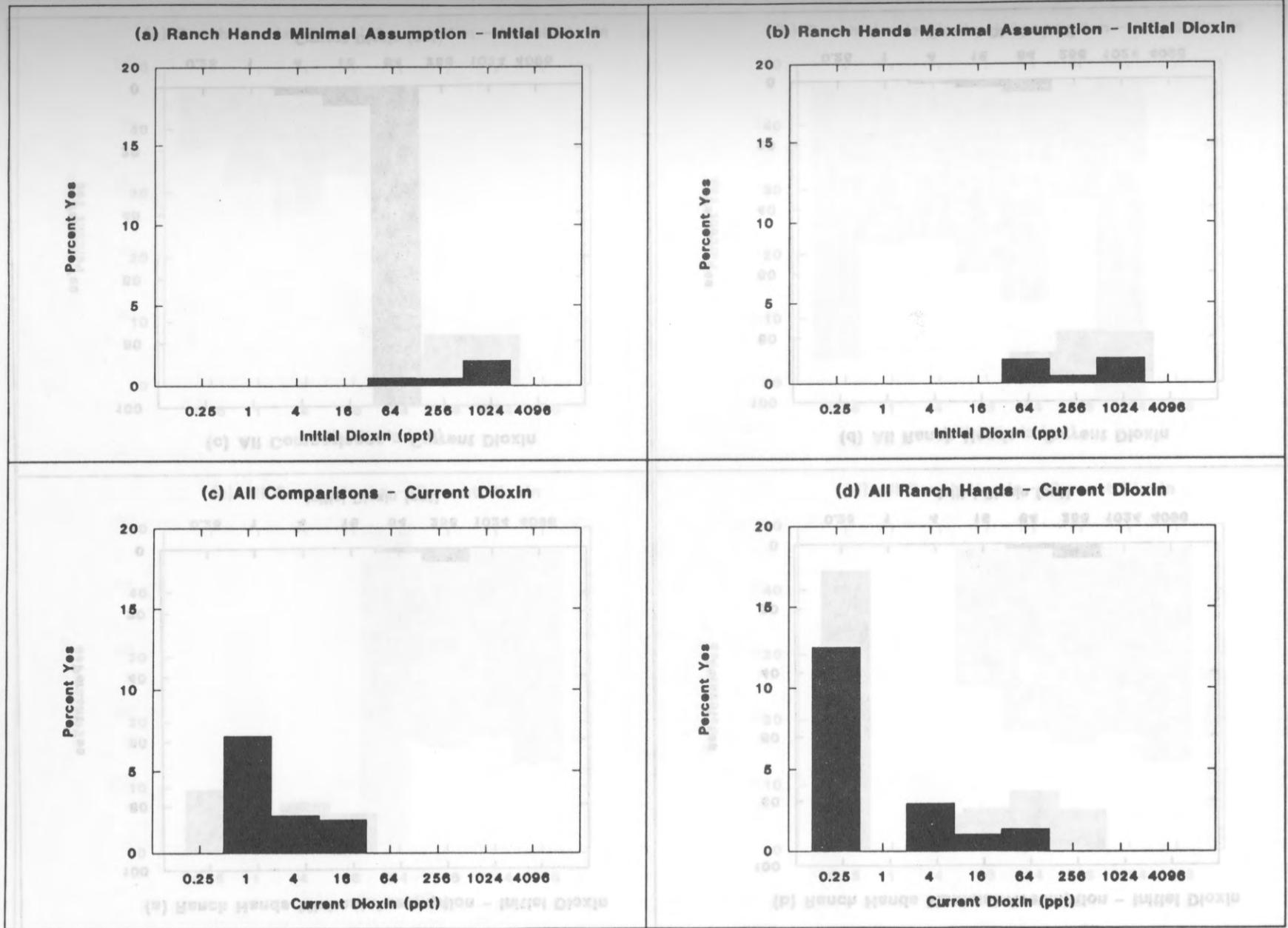
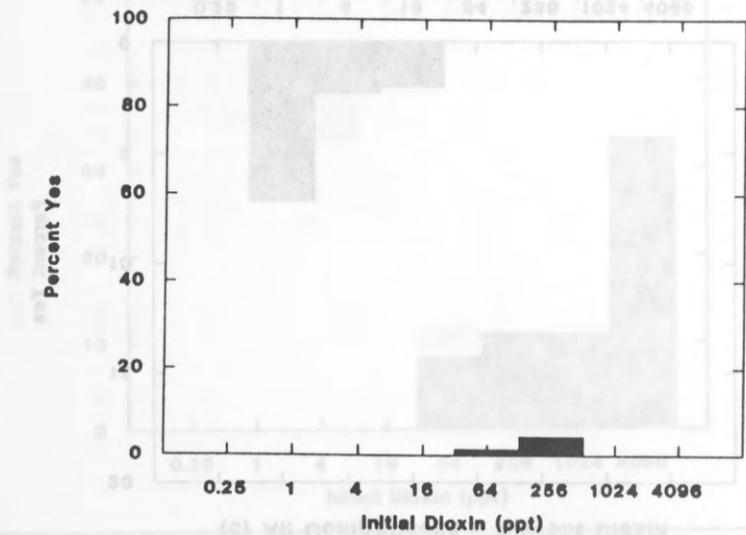


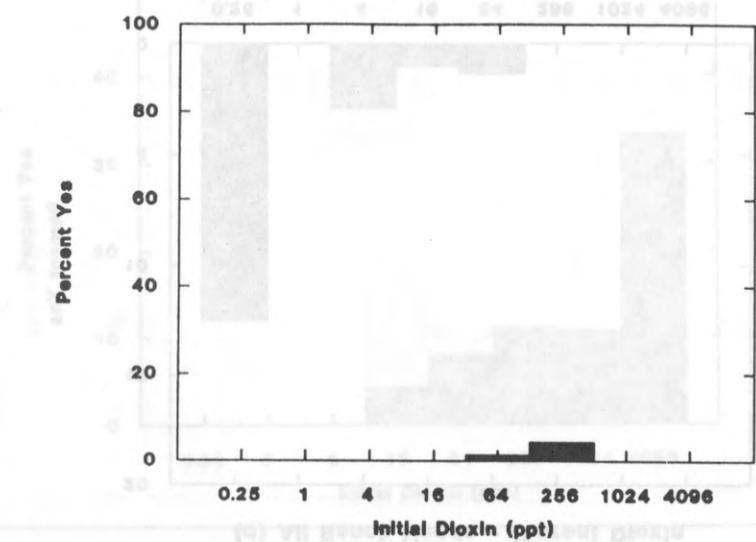
FIGURE I-1-5. Jaundice versus Dioxin

8-1-1

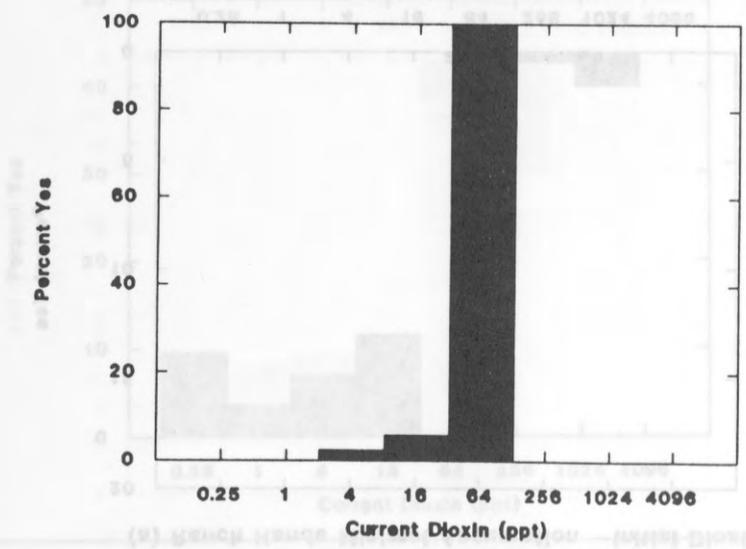
(a) Ranch Hands Minimal Assumption - Initial Dioxin



(b) Ranch Hands Maximal Assumption - Initial Dioxin



(c) All Comparisons - Current Dioxin



(d) All Ranch Hands - Current Dioxin

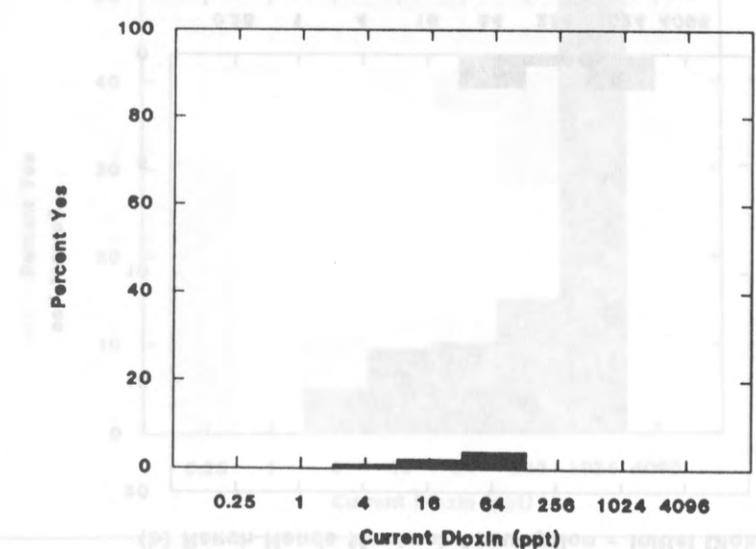


FIGURE I-1-6. Hepatomegaly versus Dioxin

6-1-10

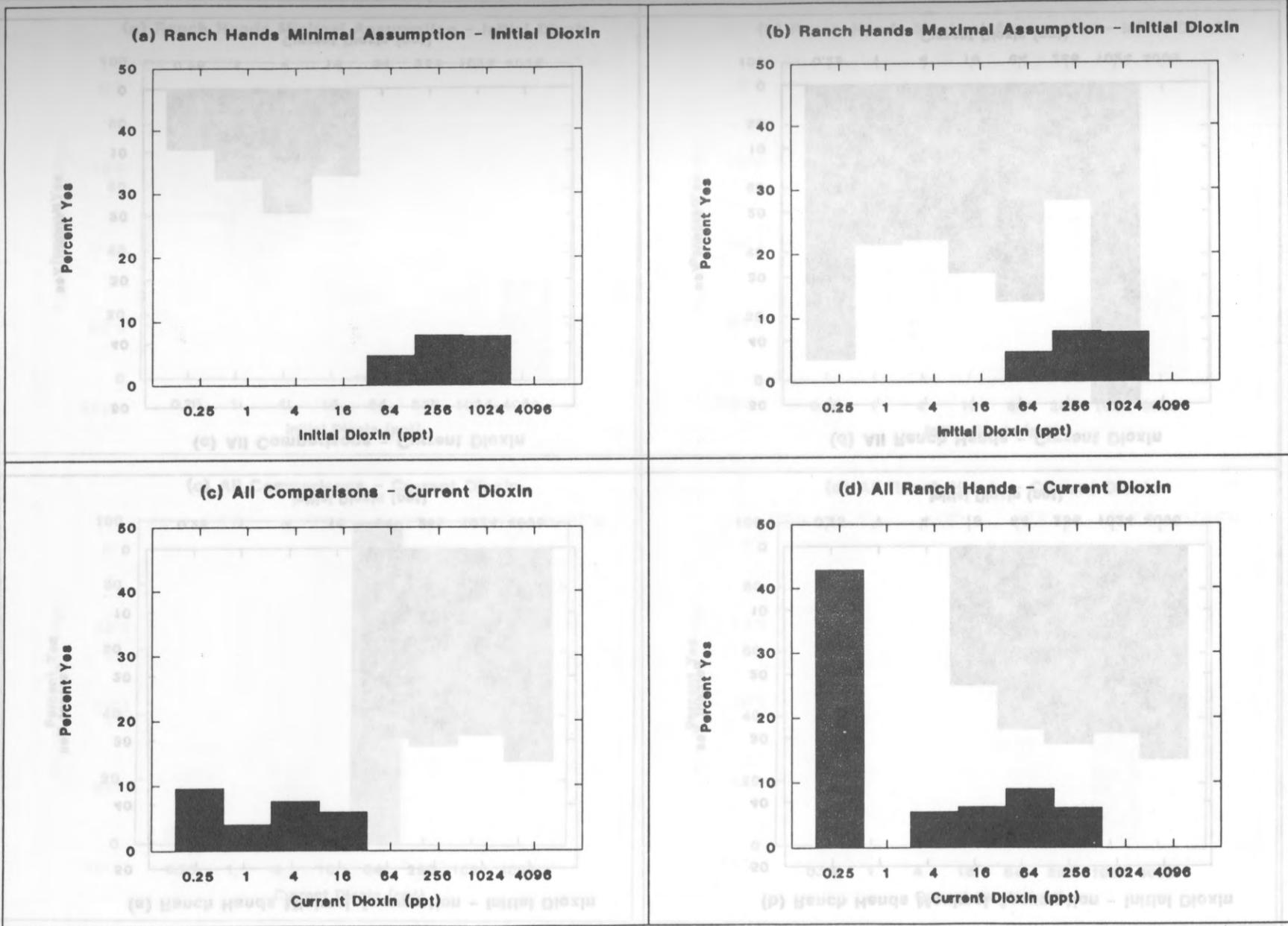


FIGURE I-1-7. Ulcer versus Dioxin

I-1-10

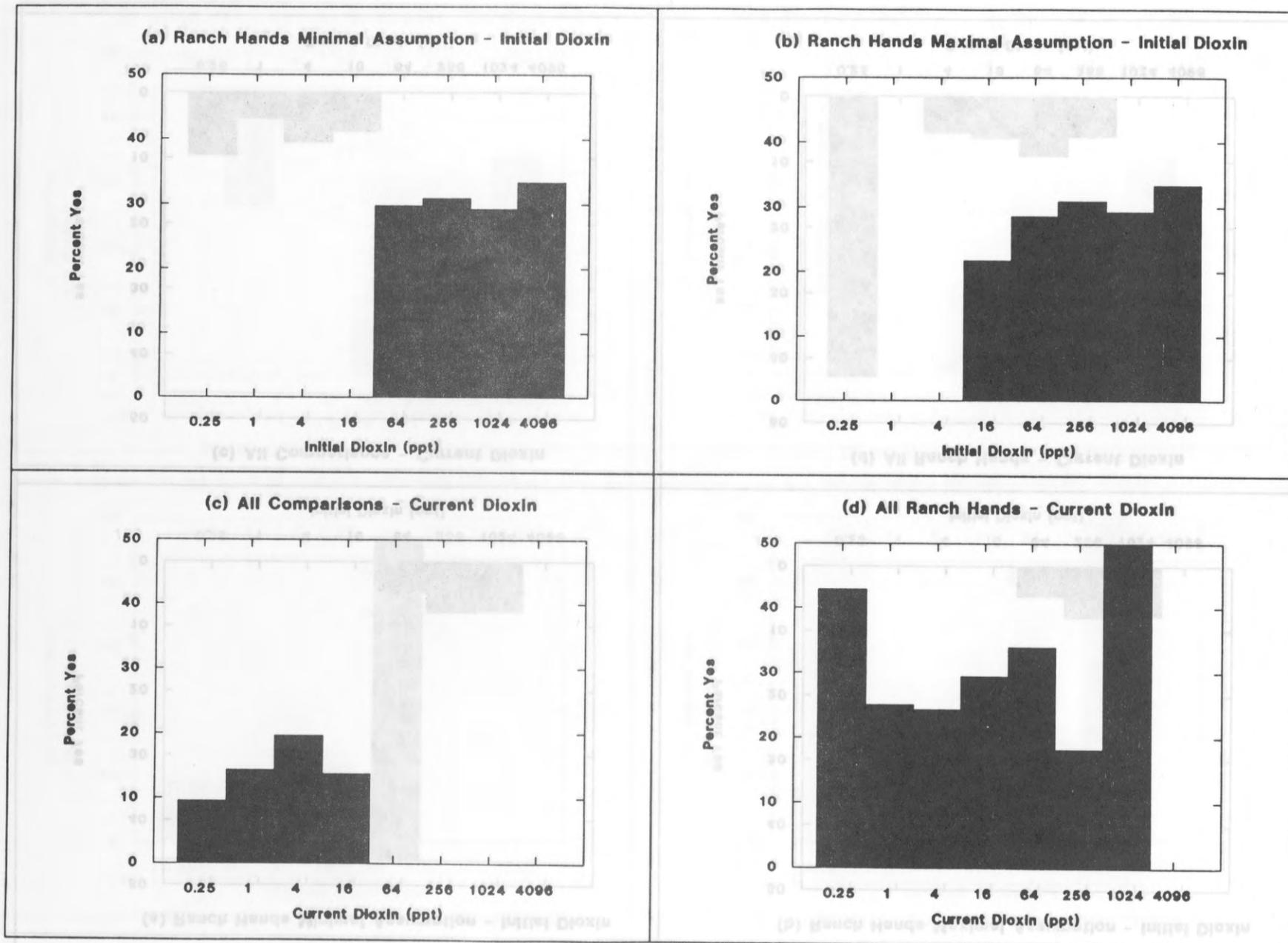


FIGURE I-1-8. Skin Bruises, Patches, or Sensitivity versus Dioxin

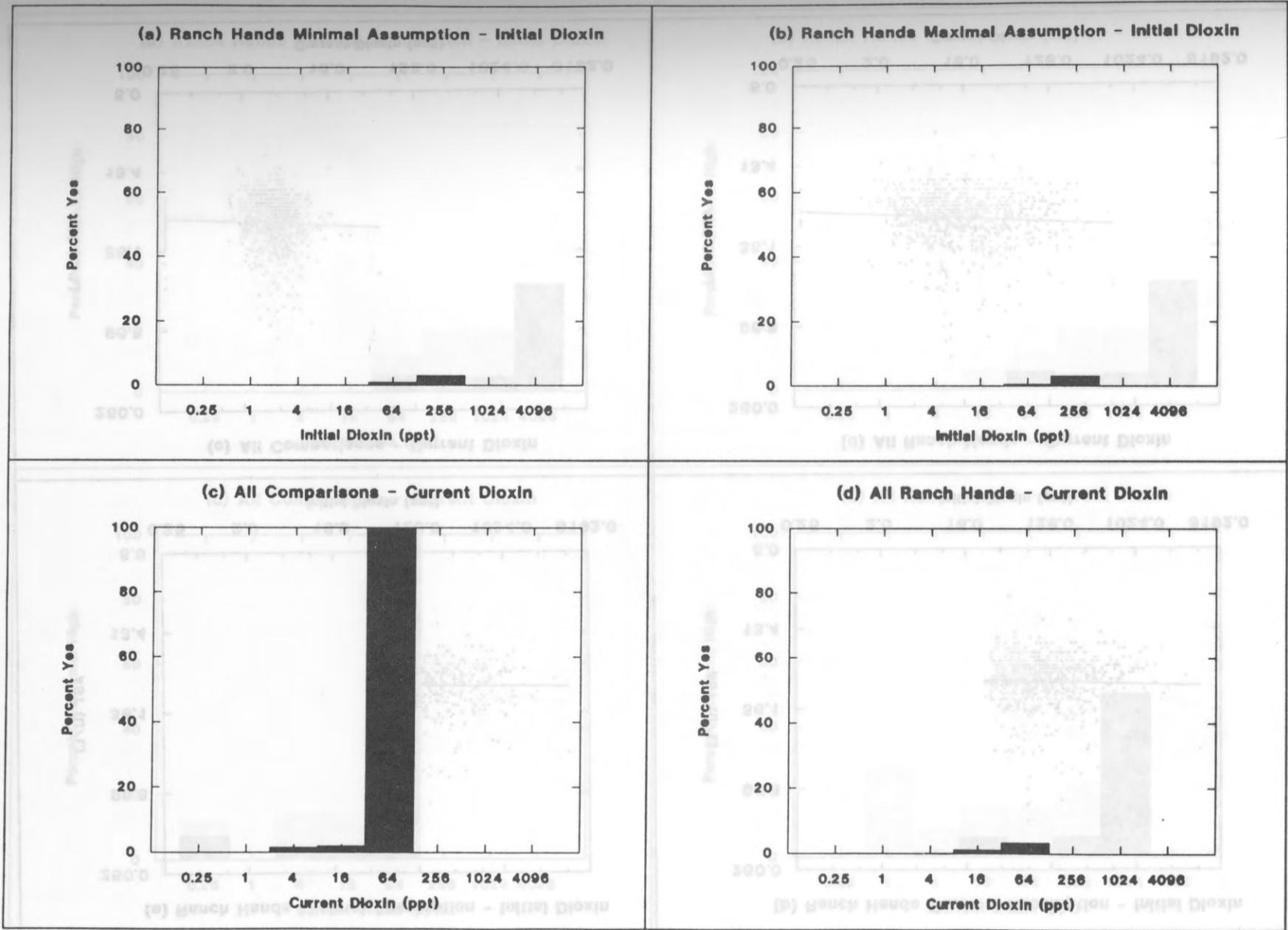


FIGURE I-1-9. Hepatomegaly (Current) versus Dioxin

I-1-12

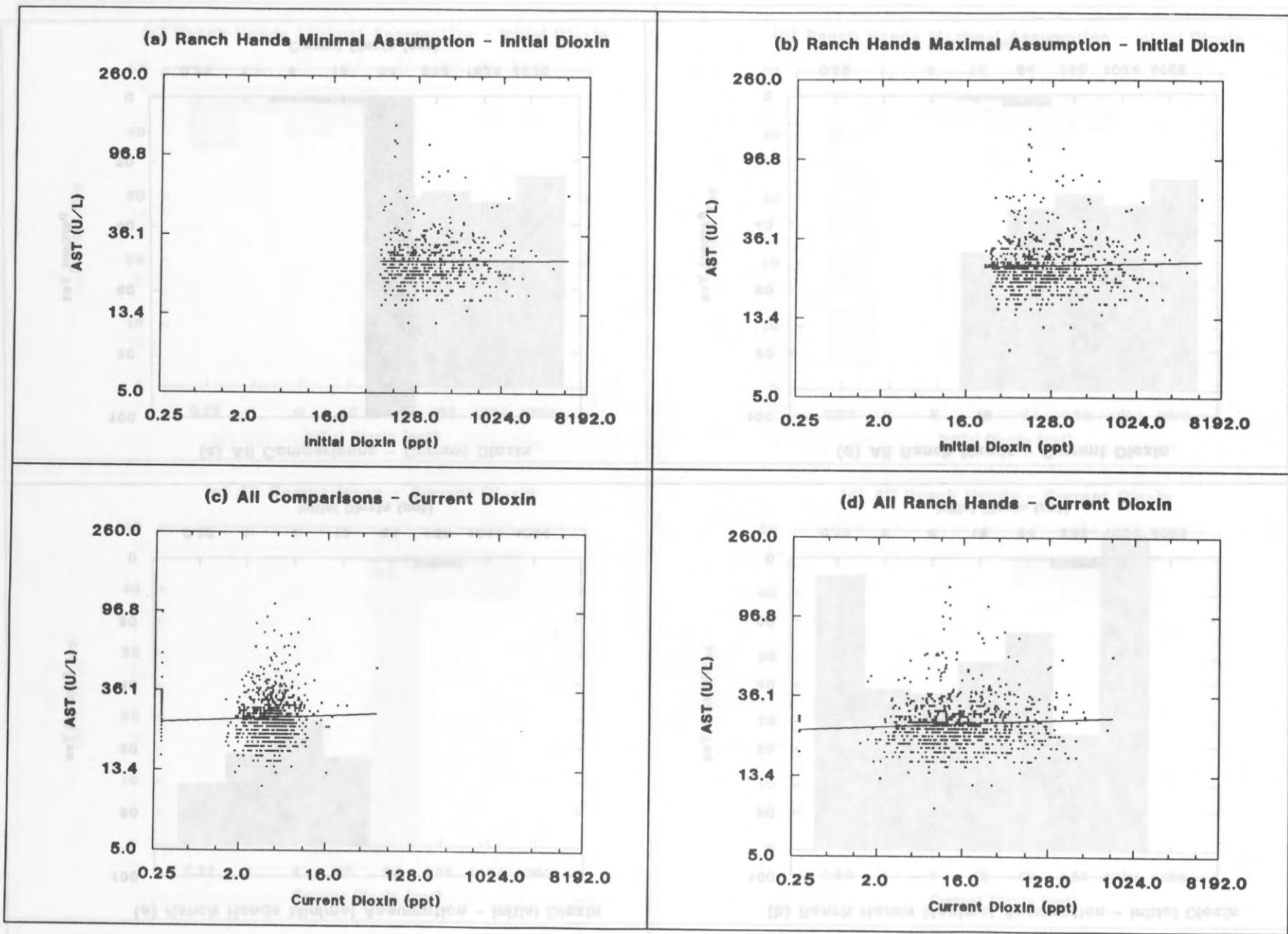


FIGURE I-1-10. AST (Continuous) versus Dioxin

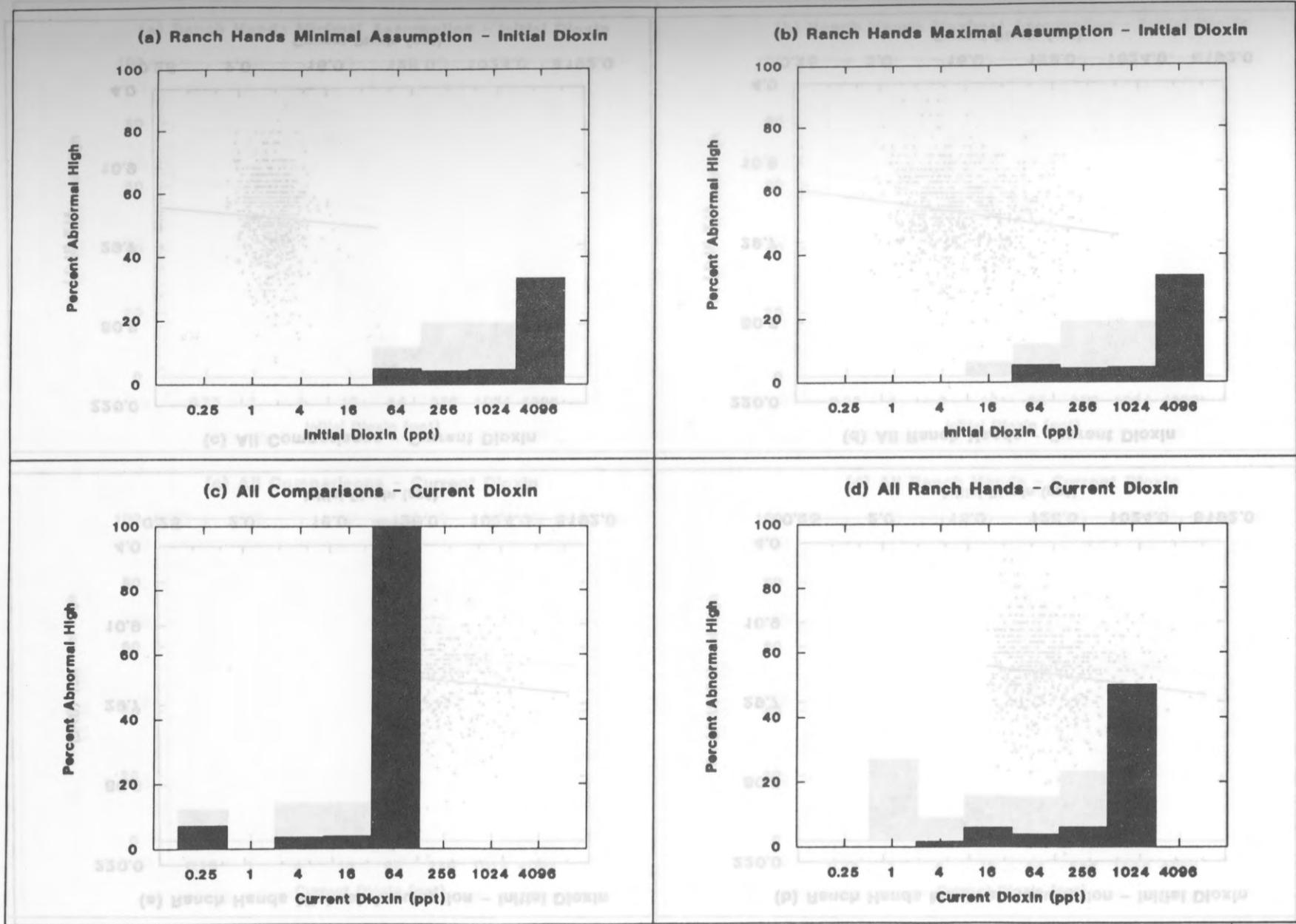


FIGURE I-1-11. AST (Discrete) versus Dioxin

I-1-14

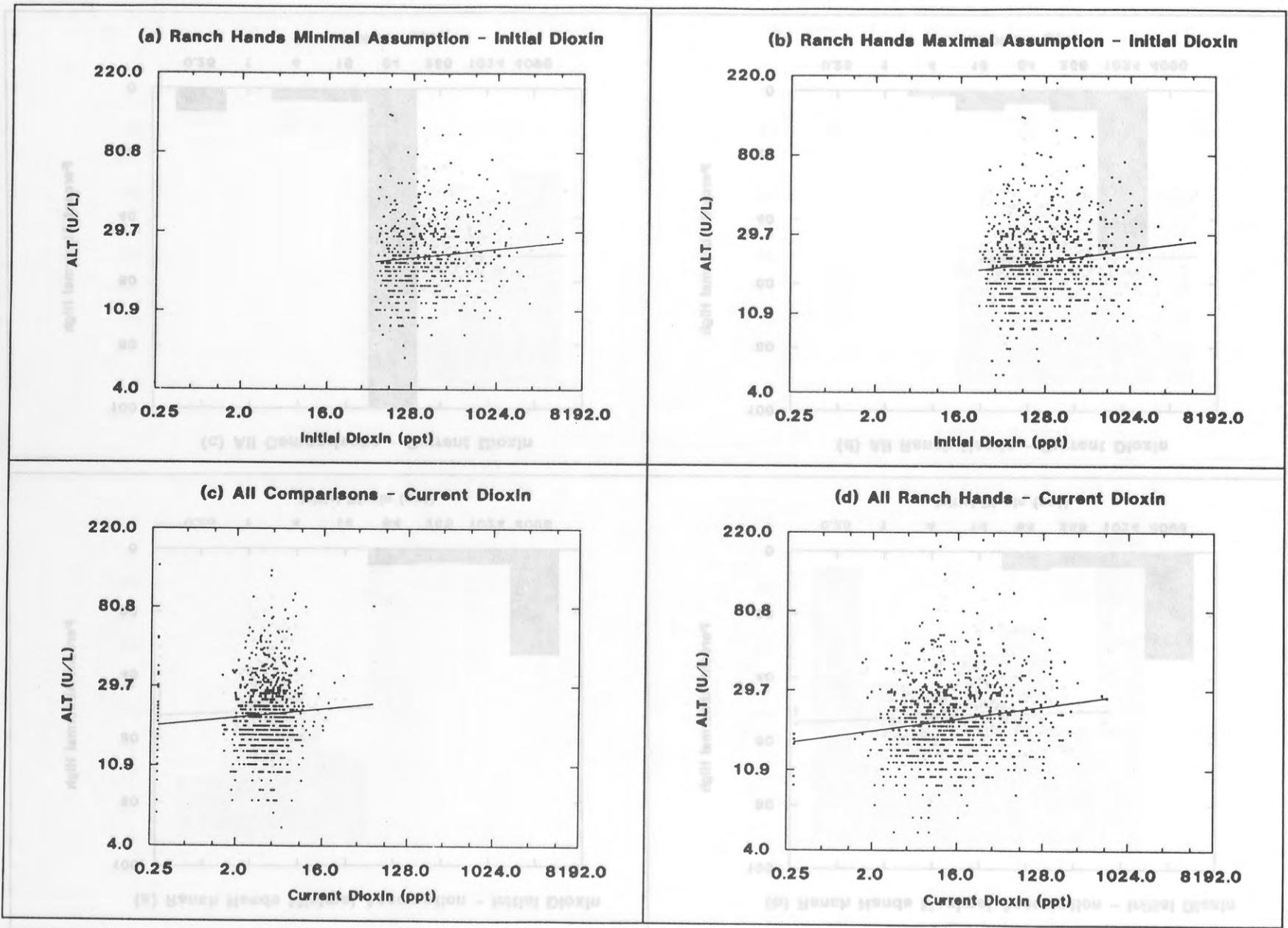


FIGURE I-1-12. ALT (Continuous) versus Dioxin

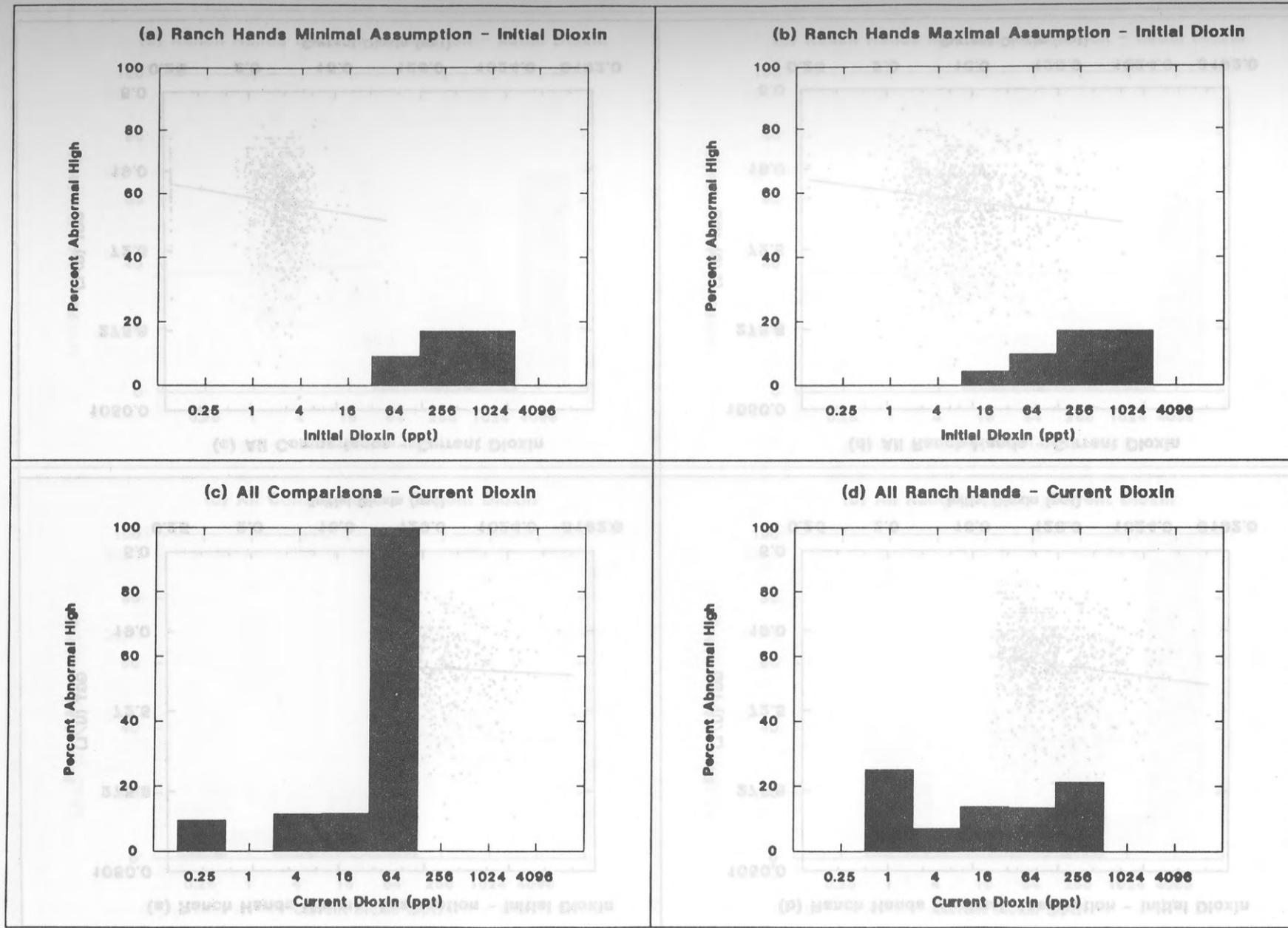


FIGURE I-1-13. ALT (Discrete) versus Dioxin

I-1-16

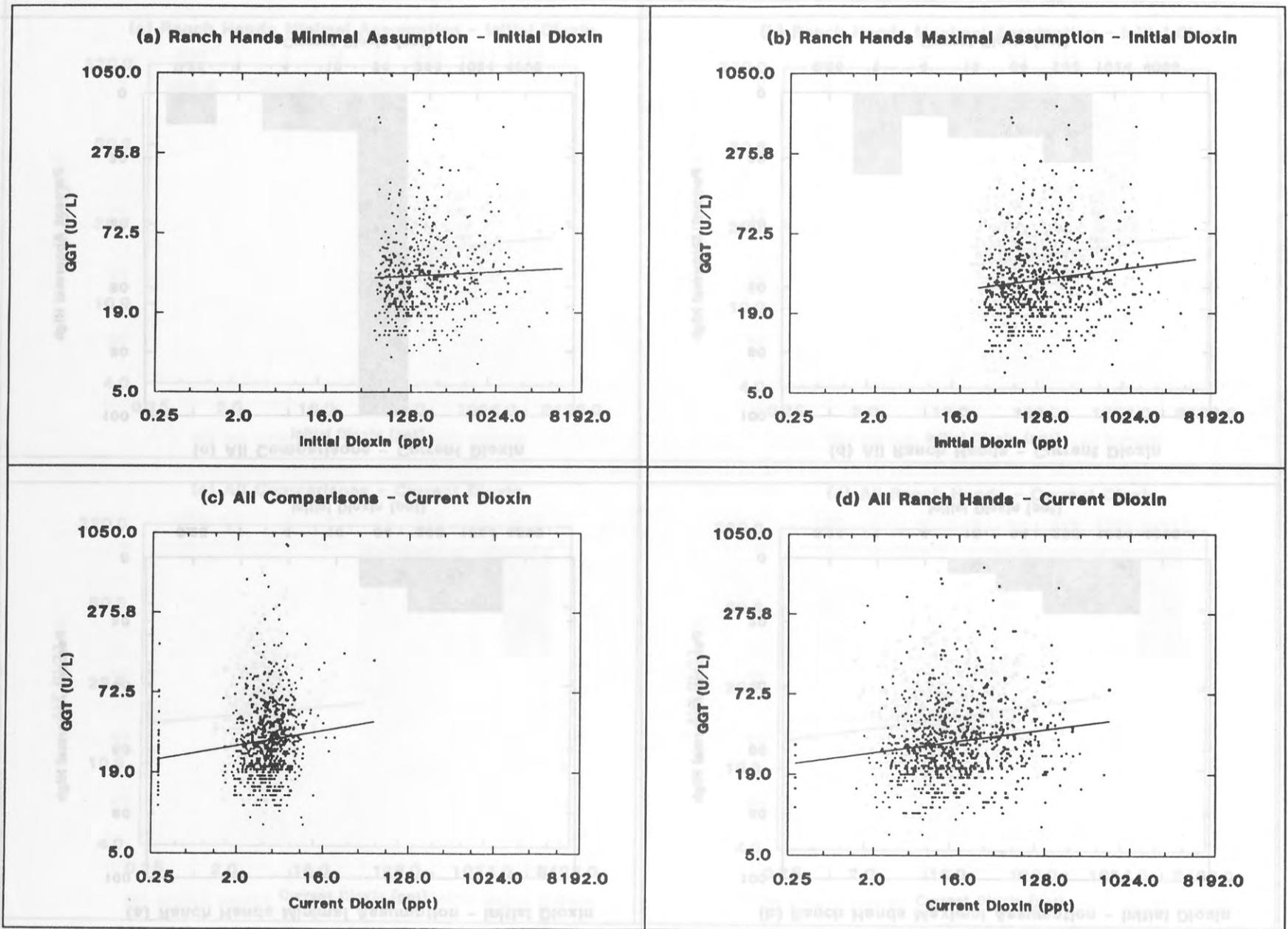
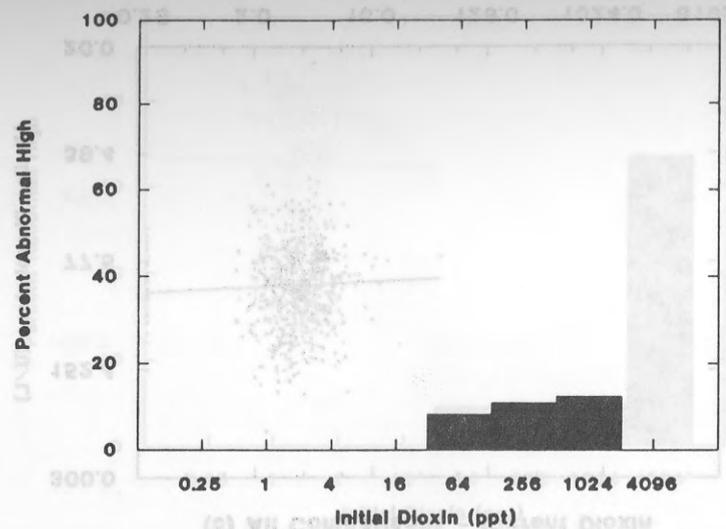


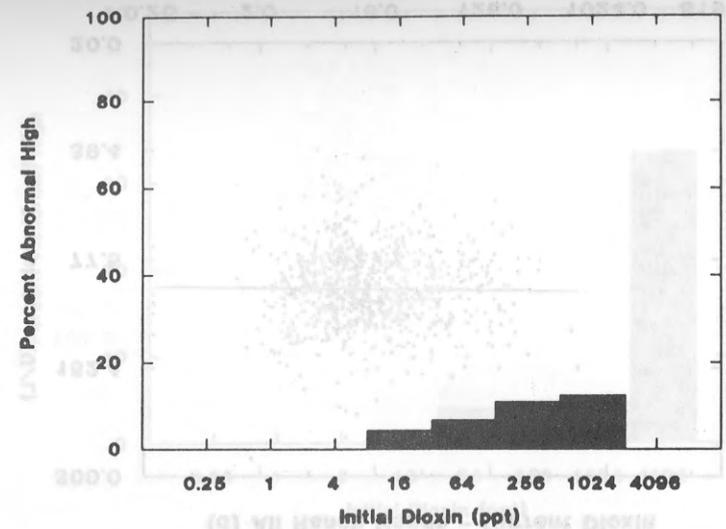
FIGURE I-1-14. GGT (Continuous) versus Dioxin

I-1-17

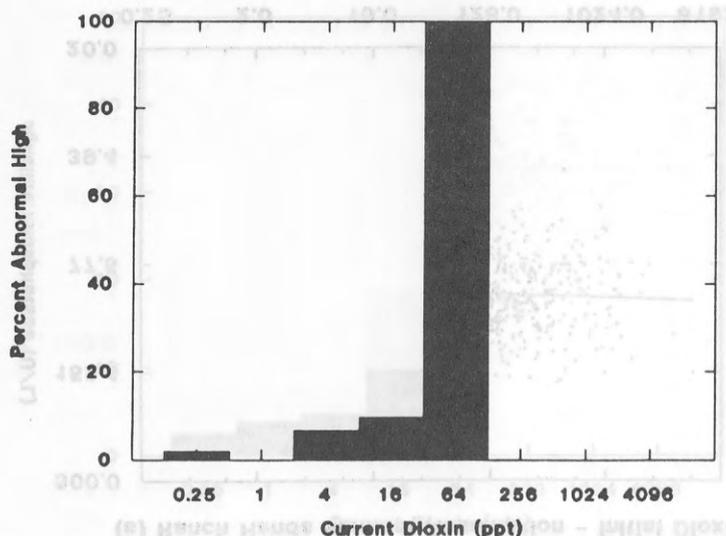
(a) Ranch Hands Minimal Assumption - Initial Dioxin



(b) Ranch Hands Maximal Assumption - Initial Dioxin



(c) All Comparisons - Current Dioxin



(d) All Ranch Hands - Current Dioxin

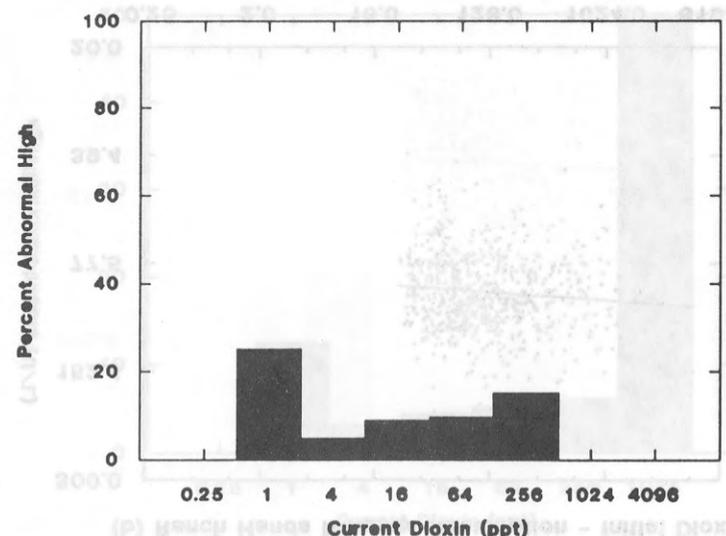
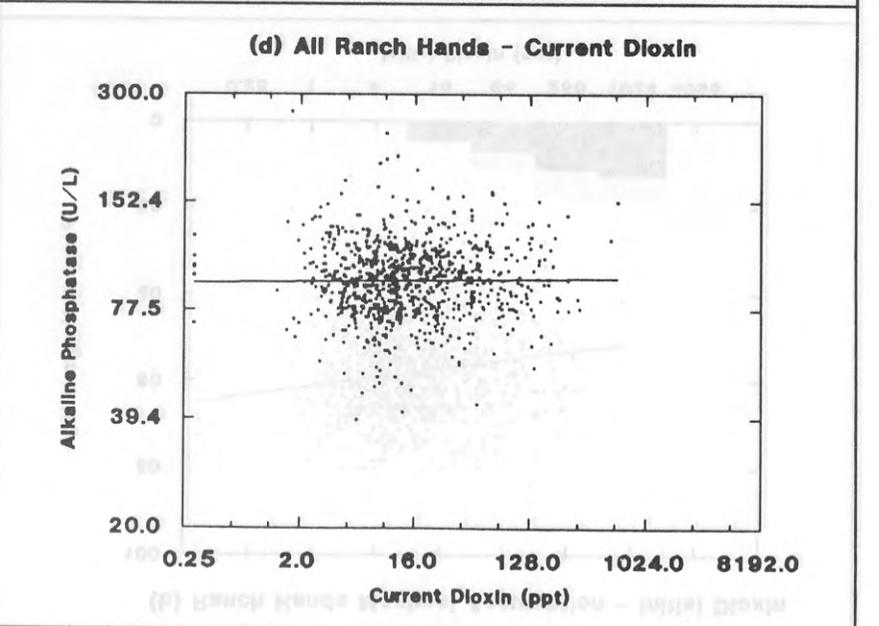
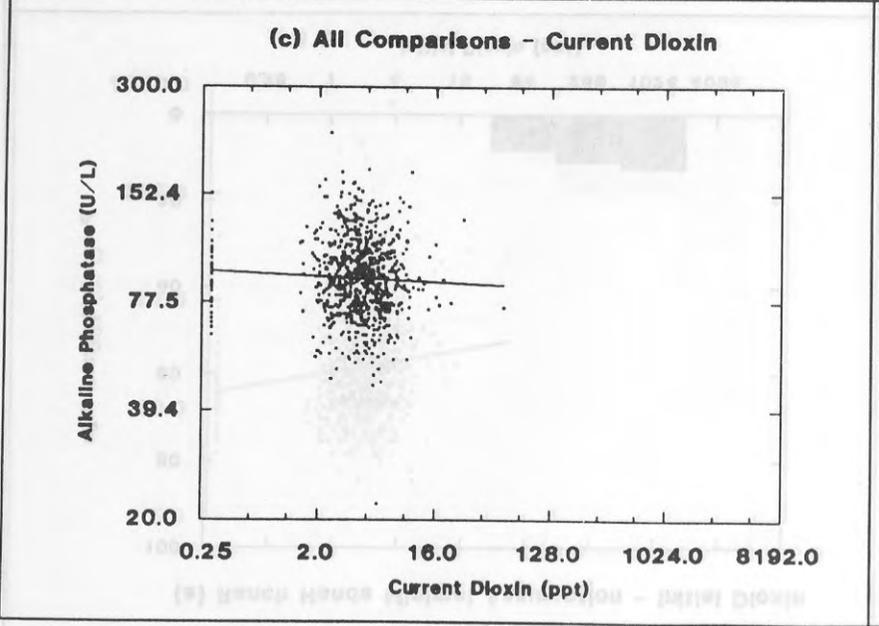
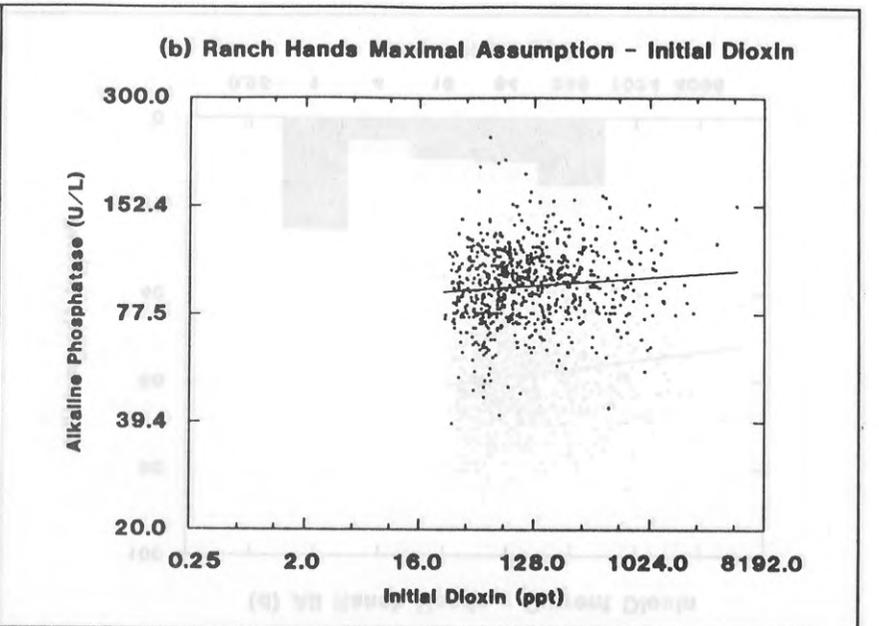
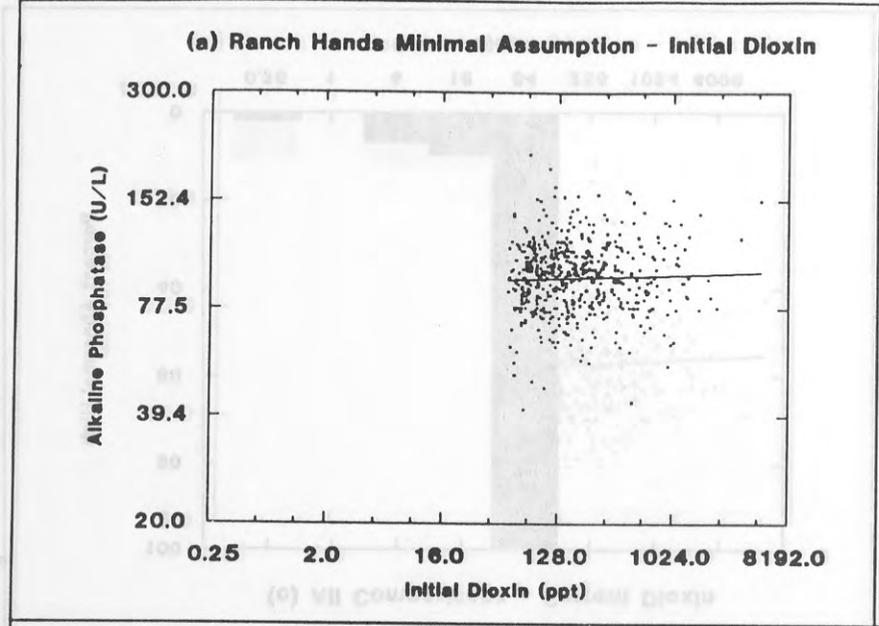


FIGURE I-1-15. GGT (Discrete) versus Dioxin

I-1-16



**FIGURE I-1-16. Alkaline Phosphatase (Continuous) versus Dioxin**

I-1-1

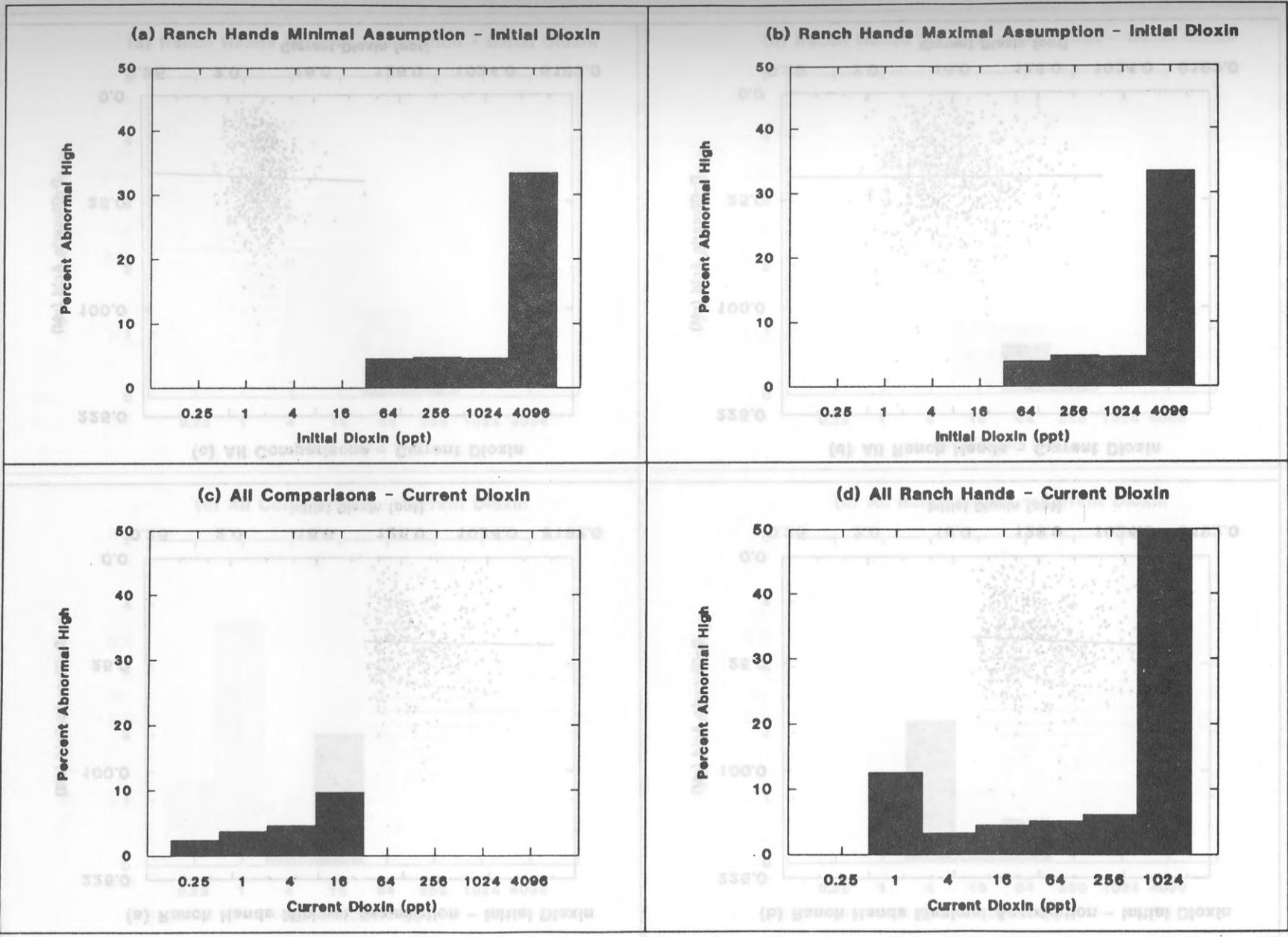


FIGURE I-1-17. Alkaline Phosphatase (Discrete) versus Dioxin

I-1-20

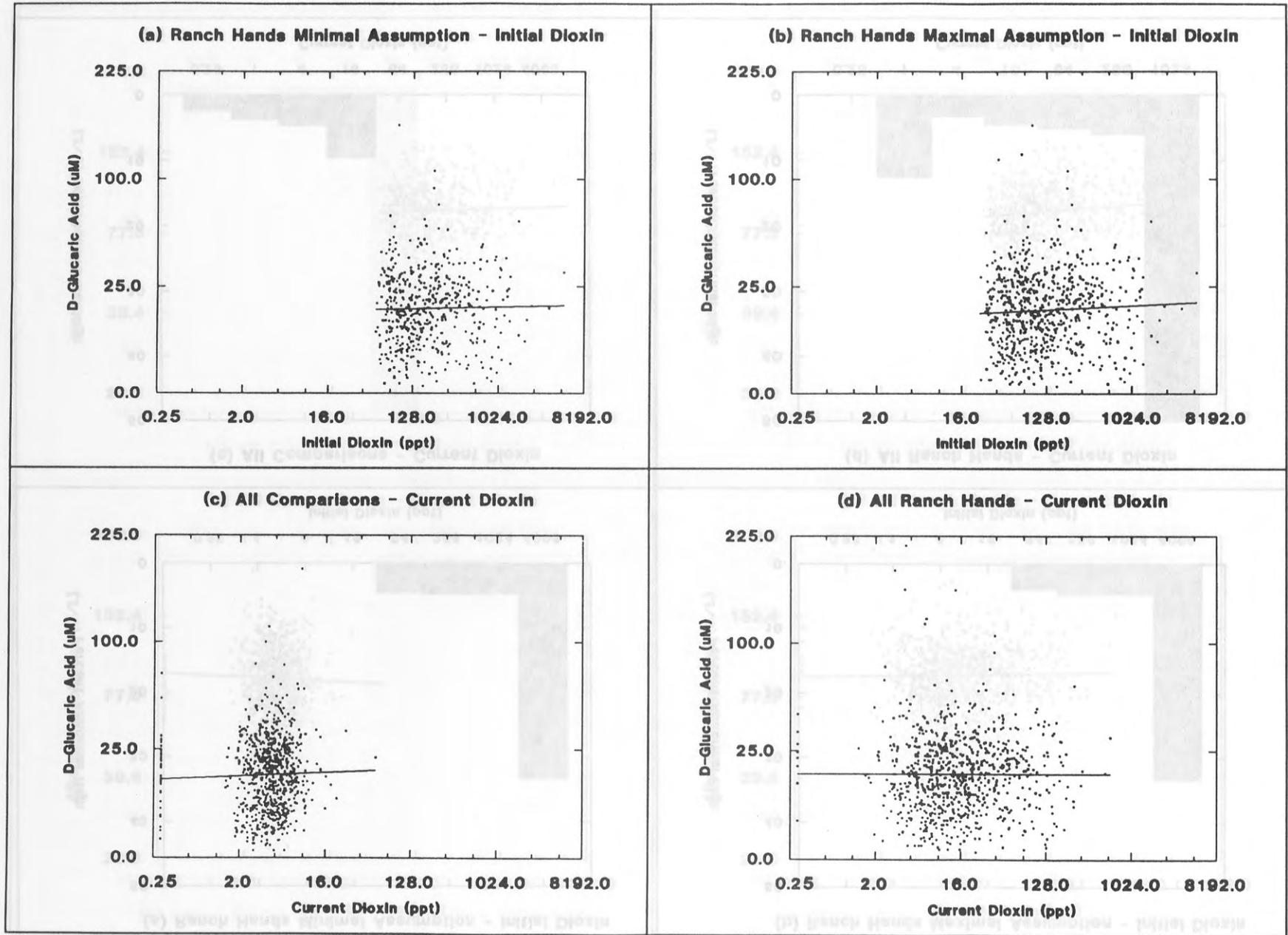


FIGURE I-1-18. D-Glucaric Acid (Continuous) versus Dioxin

I-1-21

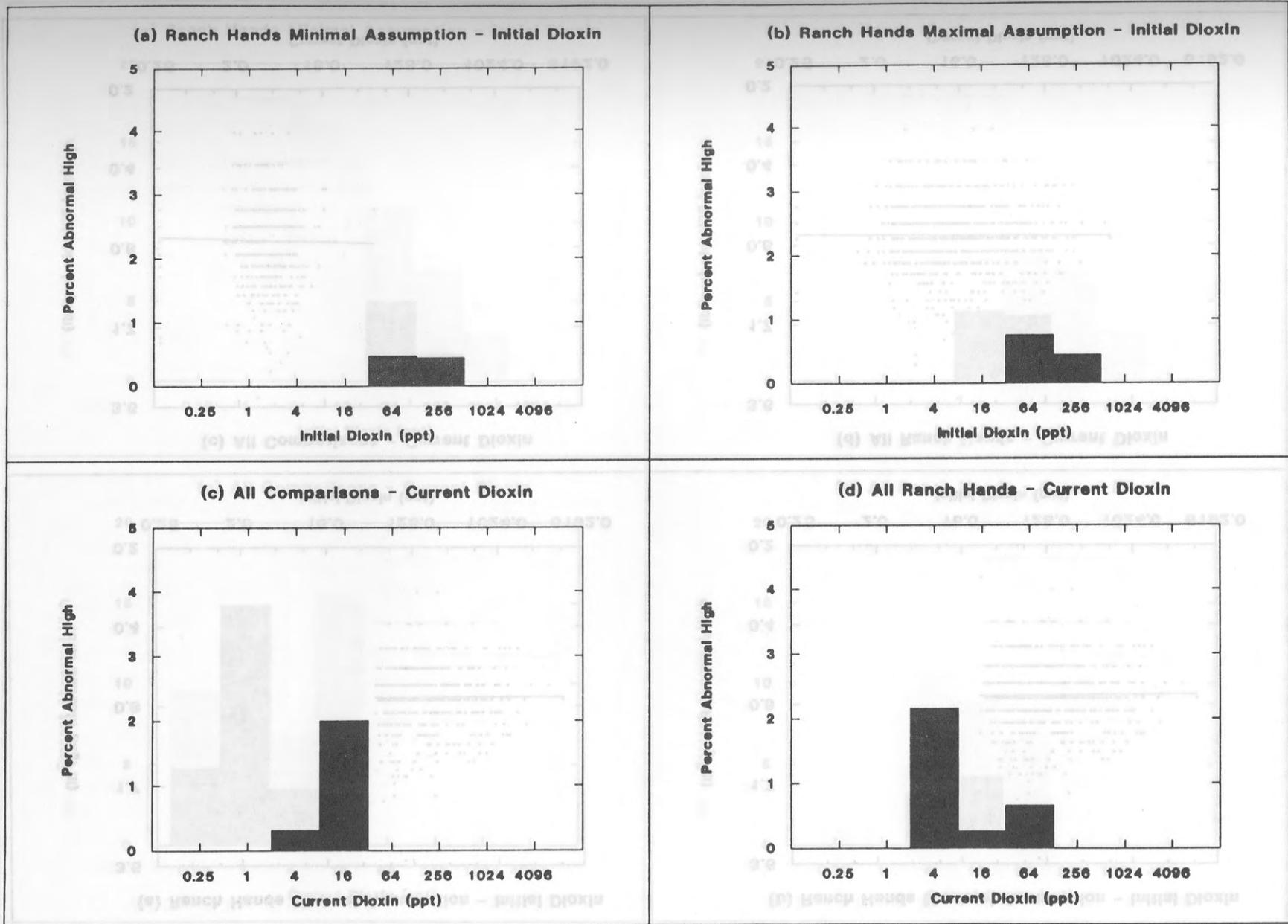


FIGURE I-1-19. D-Glucaric Acid (Discrete) versus Dioxin

I-1-22

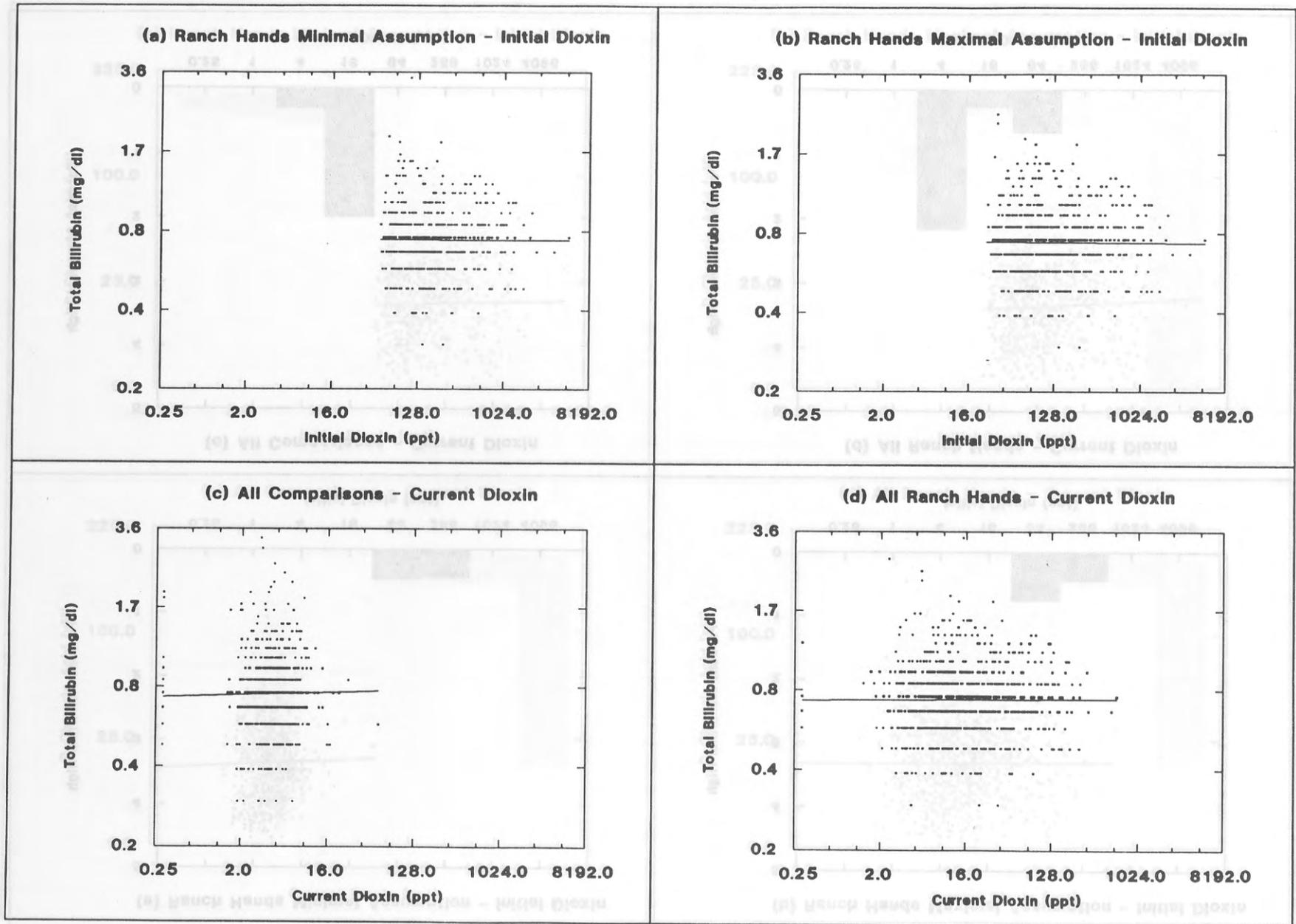


FIGURE I-1-20. Total Bilirubin (Continuous) versus Dioxin

I-1-23

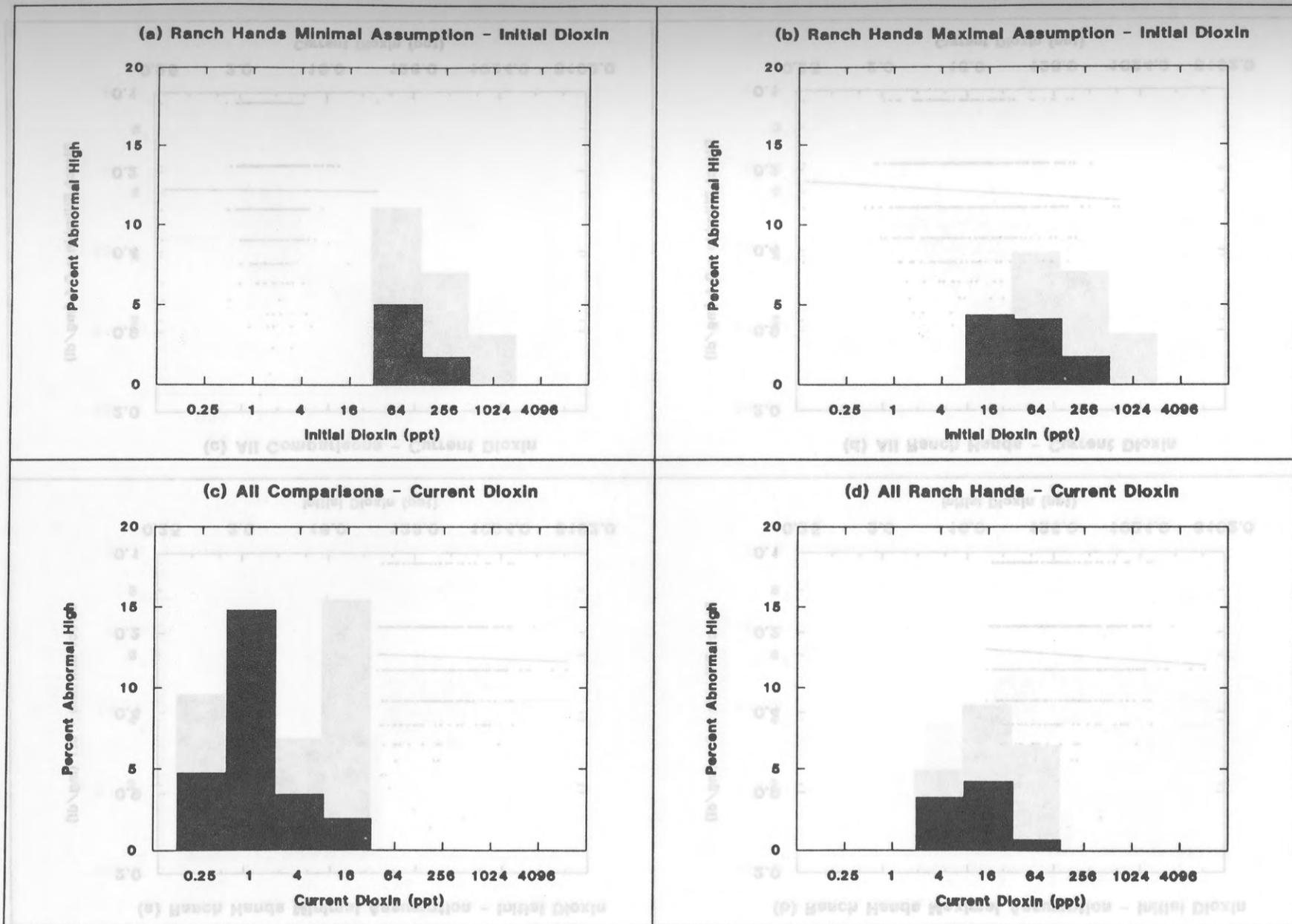


FIGURE I-1-21. Total Bilirubin (Discrete) versus Dioxin

I-1-24

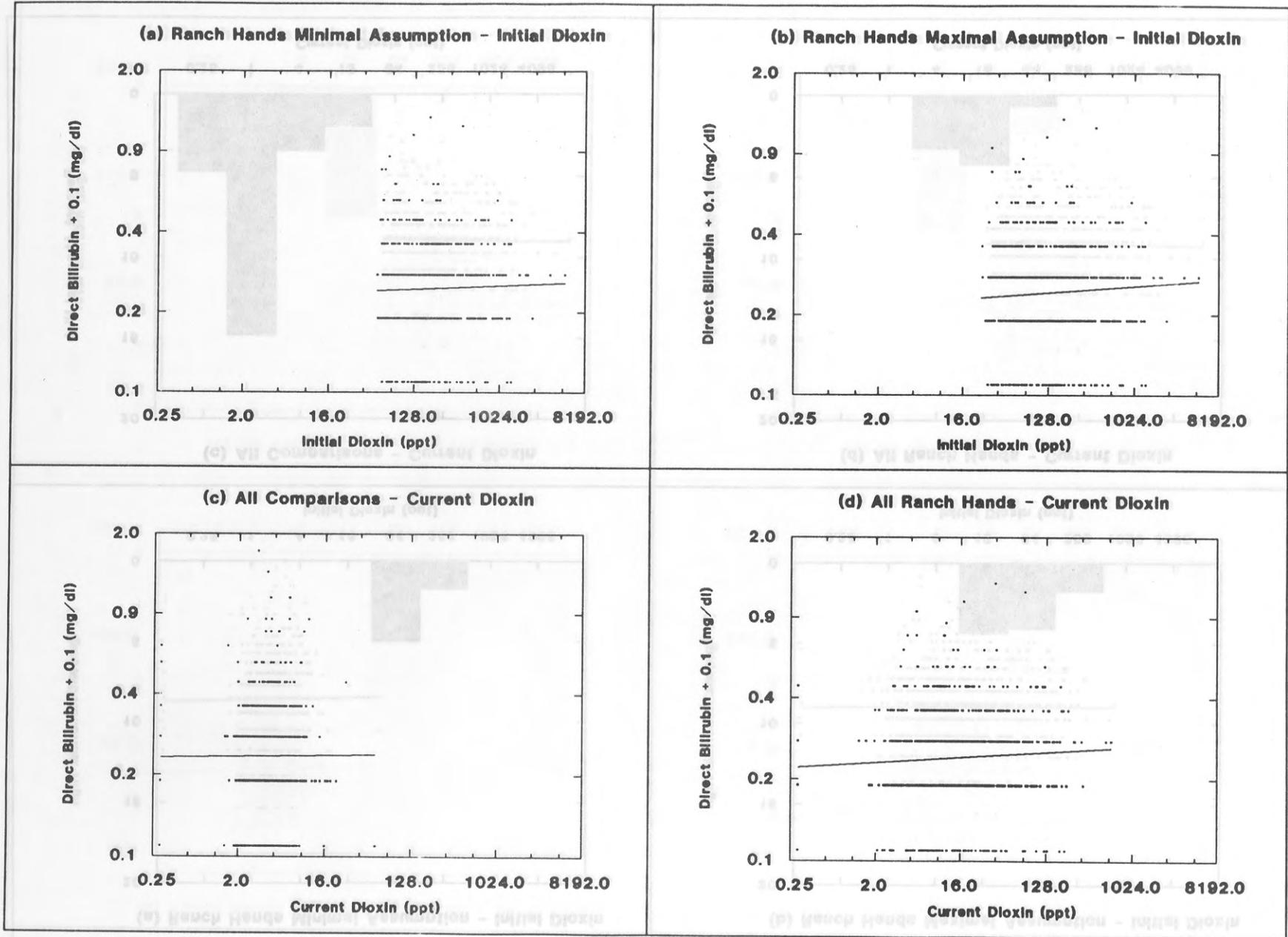


FIGURE I-1-22. Direct Bilirubin (Continuous) versus Dioxin

I-1-25

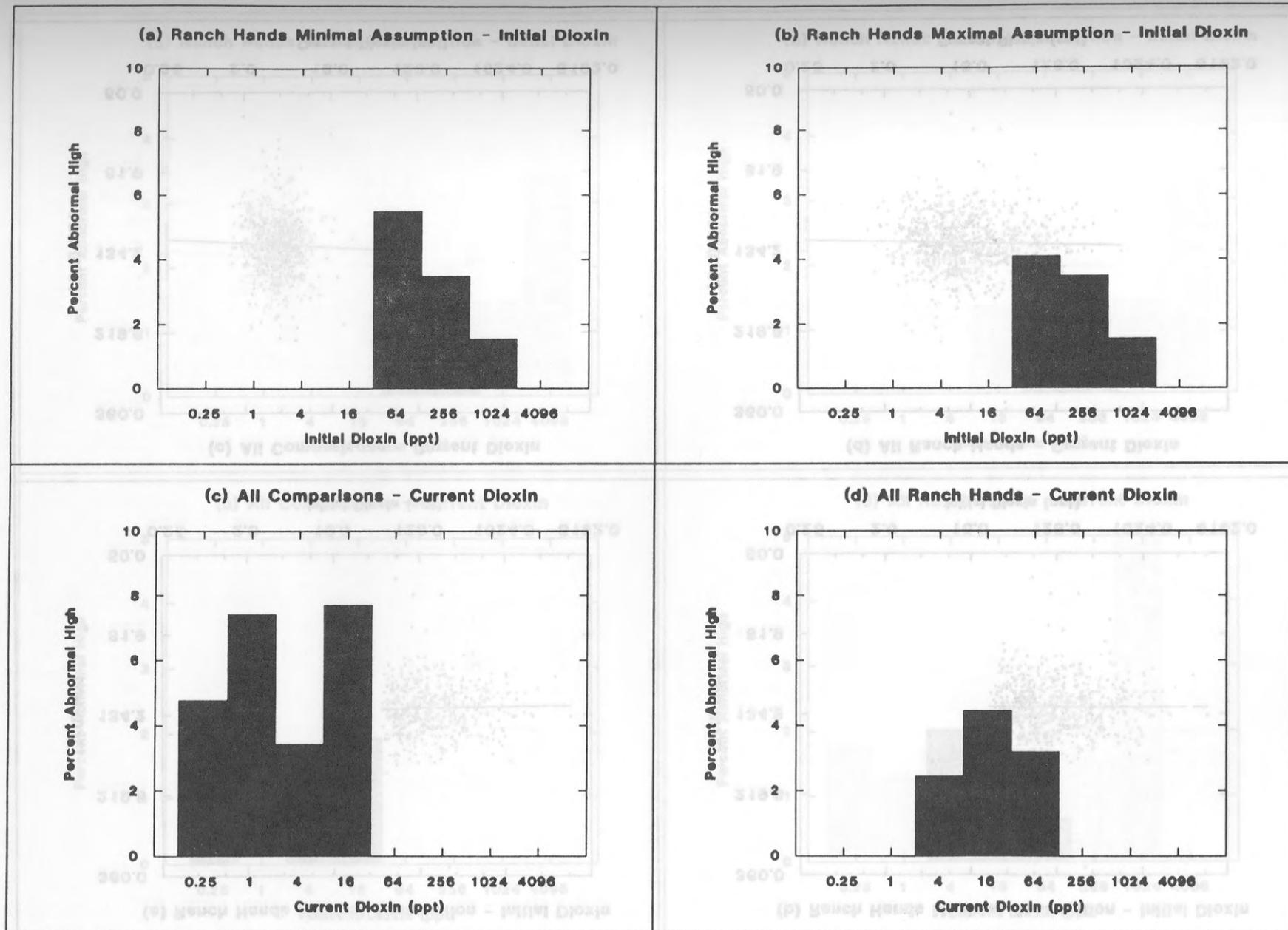


FIGURE I-1-23. Direct Bilirubin (Discrete) versus Dioxin

I-1-26

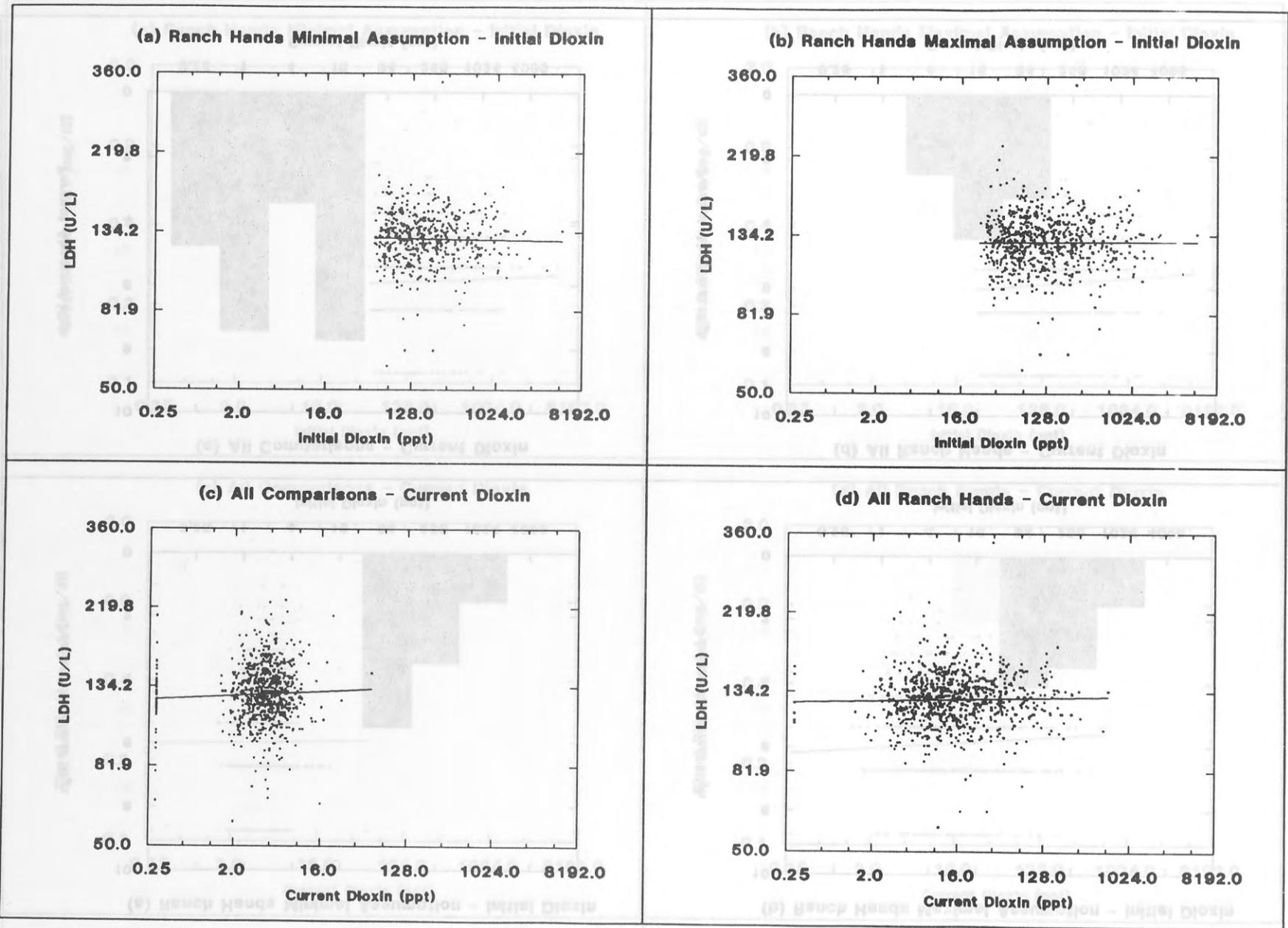


FIGURE I-1-24. LDH (Continuous) versus Dioxin