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Description Notes Paragraph summary accompanied by information in list, graphic, and table form.

EXECUTIVE SUMMARY

RANCH HAND - NAS MARINE STUDY COMPARISON

The exposed Ranch Hand cohort consists of approximately 1,200 individuals and 6,000 controls, while the proposed NAS Marine Study consists of 5,900 individuals near the herbicide flight paths, on the same day of spraying and for which there are 212,100 controls. Despite the fact that the Ranch Hand study involves smaller sample sizes than the proposed Marine effort, the Ranch Hand Study is more powerful statistically. Specifically, lower exposure to herbicide and misclassification in Marine exposure groups renders the Marine Study less powerful than the Ranch Hand effort, as set out in the attached tables and graphs. In the attached materials, misclassification and decreased exposure are seen to be independent factors additively decrementing Marine Study statistical power. Even when all 21,900 Marines within the herbicide spray paths up to 28 days following the spray operations are considered exposed, the Ranch Hand Study is noted to be significantly superior.

KEY ITEMS OF CONSIDERATION

MARINE STUDY RELATIVE TO RANCH HAND STUDY

- **“EXPOSED ” MARINES RECEIVED AN AVERAGE EXPOSURE 1/1000 THE AVERAGE DOSE RECEIVED BY RANCH HAND PERSONNEL**
- **MARINE EXPOSURE ALLOCATIONS BASED ON DISTANCE FROM SPRAY PATHS LEAD TO SERIOUS MISCLASSIFICATION OR BIAS**
- **MARINE EXPOSURE ALLOCATIONS BASED ON TIME IN A SPRAY AREA SUBSTANTIALLY ALTER THE SIZES OF THE STUDY AND CONTROL POPULATIONS AND LEAD TO SERIOUS MISCLASSIFICATION**

1979 GAO REPORT

COMPARED GROUND TROOP LOCATIONS WITH HERBICIDE ORANGE
MISSION

TIME - 1, 7, 14, 28 DAYS

GEOGRAPHY PROXIMITY - 0.5, 1.5, 2.5km

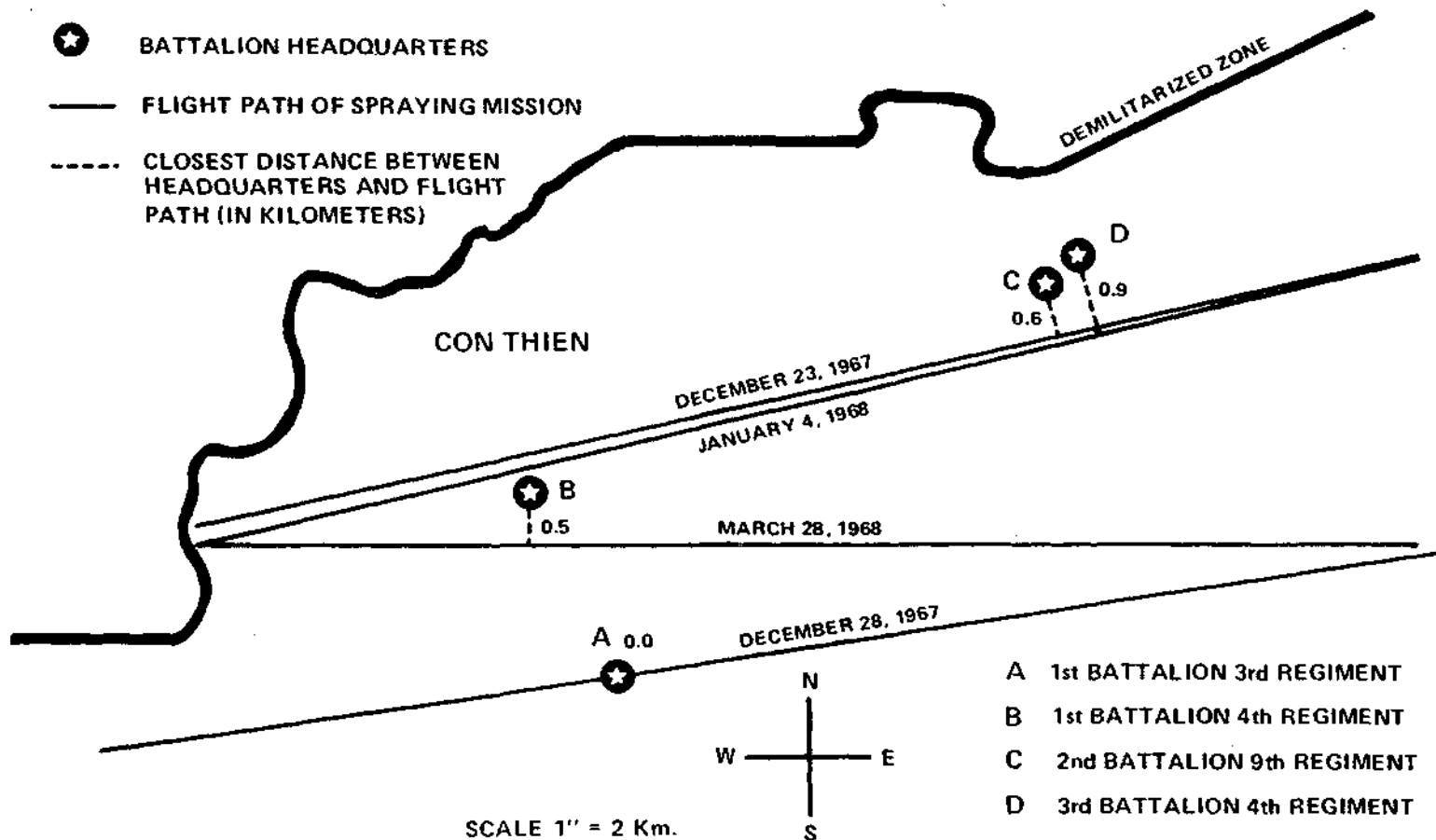
ASSUMED

BATTALION TURNOVER RATE - 202/MONTH

ALL TROOPS LOCATED AT BATTALION HQ

DRIFT IN ALL DIRECTIONS

1979 GAO REPORT
 MARINE CORPS INFANTRY BATTALIONS CLOSEST
 TO HERBICIDE ORANGE SPRAYING MISSIONS
 ON DAY OF SPRAYING (CON THIEN VACINITY)



CRITIQUE - 1979 GAO REPORT

- ATYPICAL SPRAYING IN DMZ
- INADEQUATE RECORDS BELOW BATTALION LEVEL
- TEN PERCENT OF TROOPS AT BATTALION HQ
- REMAINING TROOPS IN "ROVING UNITS"
- UNIT LOCATIONS ONLY FOR COMBAT ACTION
- HEAVY VEGETATION/MOUNTAIN TERRAIN MINIMIZED
GROUND LEVEL EXPOSURE
- SPRAY DRIFT LIMITED AND DIRECTIONAL
- ENVIRONMENTAL FATE DISREGARDED

FATE IN AIR (HERBICIDE)

PARTICLE SIZE

<100 μ 1.9%

100-500 μ 76.2%

>500 μ 21.9%

87% IMPACT WITHIN 1 MIN

13% DRIFT/VOLATILIZE (?)

PHOTODEGRADATION

FATE ON VEGETATION (HERBICIDE)

MULTICANOPY FOREST INTERCEPTED ~ 94%

GROUND - LEVEL DEPOSITION ~ 6%

(0.17 GAL/A = 1.4 LB AI/A)

CUTICULAR PENETRATION OCCURRED WITHIN 30 MIN

ENVIRONMENTAL FATE OF TCDD

RAPID PHOTODEGRADATION IN AIR/PLANT SURFACE

(CROSSBY, > 98% IN 6 HR)

(NASH, 86% IN 32 HR)

MIN TRANSLOCATION IN PLANTS

NEG. PLANT UPTAKE

SOIL: 20% PHOTODEGRADES IN 6 HR

T $1/2$ WITH HERBICIDE = 1 YEAR

T $1/2$ WITHOUT HERBICIDE = 3 YEARS

BIOACCUMULATION IN ANIMALS

(EGLIN AFB STUDY)

**CONSIDERATION OF THE EXPOSURE
ALLOCATION FOR THE MARINE POPULATION**

SUBJECTIVE MEANS: PERSONAL HISTORY OF THE MARINES

**PROBLEMS: BIAS FROM COMPENSATION CARROT MISIDENTIFICATION
OF SPRAYING AIRCRAFT**

PROBABLE RESULTS: POSITIVE HISTORIES

RESULTING EFFECT: SUBSTANTIAL POSITIVE BIAS

CONSIDERATION OF THE EXPOSURE ALLOCATION FOR THE MARINE POPULATION

"OBJECTIVE" MEANS: HERB TAPES; GEOGRAPHIC PROXIMITY OF MARINE HQs TO SPRAY PATHS

PROBLEMS: TAPE INACCURACIES; COMBAT MANEUVERS OF MARINES FROM HQs; SHORT ENVIRONMENTAL FATE OF TCDD; CONFOUNDING EXPOSURE TO CONTROL GROUP VIA PERIMETER GROUND SPRAYING

PROBABLE RESULT: SUBSTANTIAL MISCLASSIFICATION OF "EXPOSED" GROUP PLUS MINOR MISCLASSIFICATION OF "UNEXPOSED" CONTROL GROUP

RESULTING EFFECT: SUBSTANTIAL DILUTION OF HEATH EFFECTS, IF PRESENT SIGNIFICANT DILUTION OF EFFECTS IF MARINES ADDED TO RANCH HAND POPULATION FOR STUDY

MORTALITY ANALYSIS

POWER COMPARISON OF THE RANCH HAND STUDY TO THE MARINE POPULATION CONSIDERING MISCLASSIFICATION AND RELATIVE EXPOSURE

POWER TABLE

RANCH HAND POWER 1-B	% MISCLASSIFICATION	MARINE STUDY POWER EXPOSURE LEVELS RELATIVE TO RANCH HAND			
		1/10	1/20	1/100	1/1000
.92	0	.19	.10	.06	.05
	10	.17	.10	.06	.05
	25	.14	.09	.06	.05

ASSUMPTIONS: RH STUDY POP. 1,200: 6,000 (1:5)
MARINE STUDY POP. 5,900: 212,100
NORMAL INCIDENCE OF DISEASE = 0.01
DISEASE INCIDENCE IN RH = 0.02
LINEAR DOSE - RESPONSE
MISCLASS. OF MARINE CONTROLS EXCLUDED

MORTALITY ANALYSIS

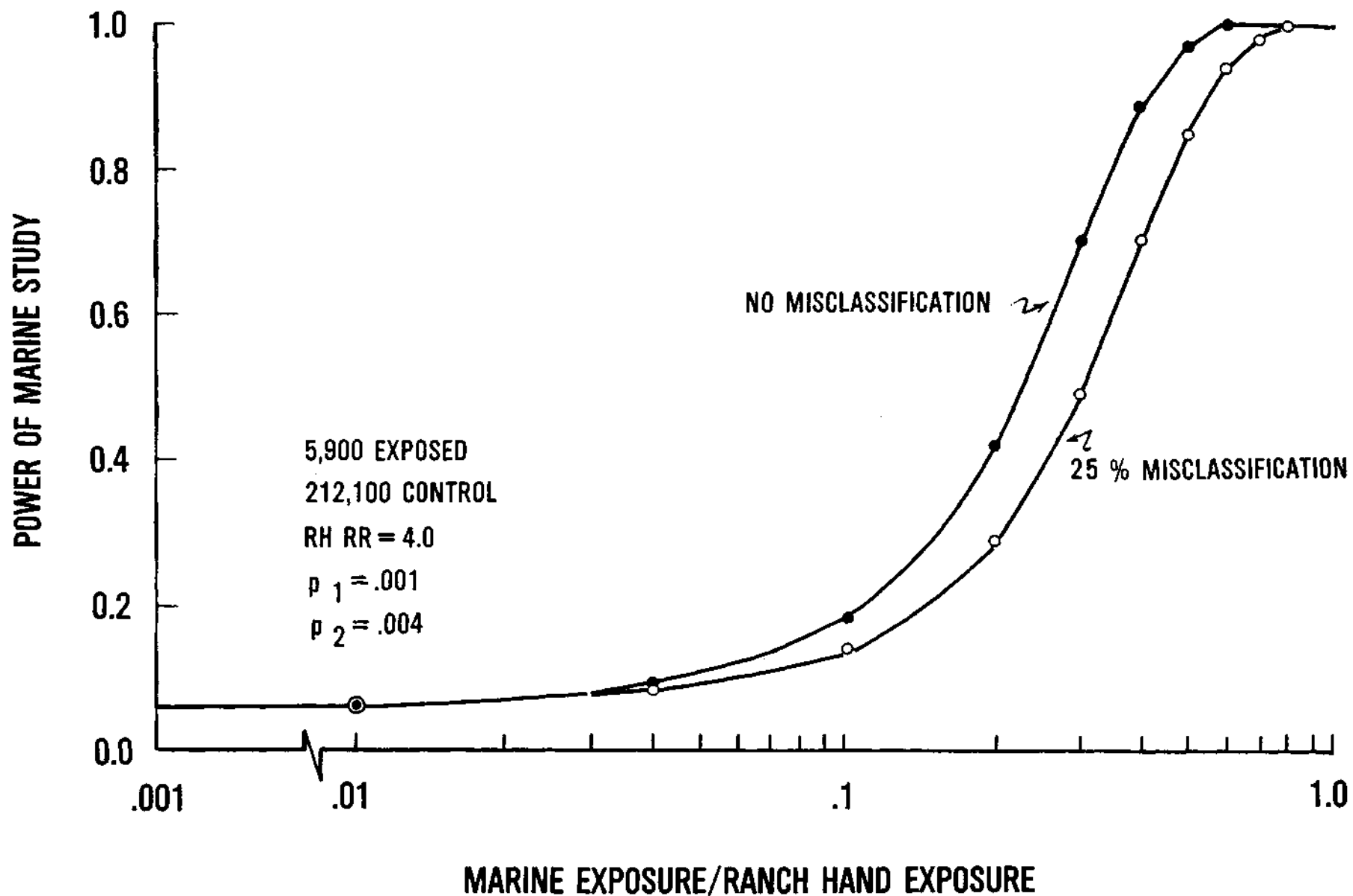
POWER COMPARISON OF THE RANCH HAND STUDY TO THE MARINE POPULATION CONSIDERING MISCLASSIFICATION AND RELATIVE EXPOSURE

POWER TABLE

RANCH HAND POWER 1-B	% MISCLASSIFICATION	MARINE STUDY POWER			
		EXPOSURE LEVELS RELATIVE TO RANCH HAND			
		1/10	1/20	1/100	1/1000
.87	0	.18	.10	.06	.05
	10	.16	.09	.06	.05
	25	.15	.09	.06	.05

ASSUMPTIONS: RH STUDY POP. 1,200: 6,000 (1:5)
MARINE STUDY POP. 5,900: 212,100
NORMAL INCIDENCE OF DISEASE 0.001
DISEASE INCIDENCE IN RH 0.004
LINEAR DOSE - RESPONSE
MISCLASS. OF MARINE CONTROLS EXCLUDED

POWER CURVES OF THE MARINE STUDY CONSIDERING RELATIVE EXPOSURE AND MISCLASSIFICATION OF THE STUDY POPULATION



MORTALITY ANALYSIS

POWER COMPARISON OF THE RANCH HAND STUDY TO THE MARINE POPULATION CONSIDERING MISCLASSIFICATION AND RELATIVE EXPOSURE *

POWER TABLE

RANCH HAND POWER 1-B	% MISCLASSIFICATION	MARINE STUDY POWER			
		EXPOSURE LEVELS RELATIVE TO RANCH HAND			
		1/10	1/20	1/100	1/1000
.92	0	.41	.17	.07	.05
	10	.36	.16	.07	.05
	25	.28	.13	.06	.05

ASSUMPTIONS: RH STUDY POP. 1,200; 6,000 (1:5)
 MARINE STUDY POP. 21,900; 196,100
 NORMAL INCIDENCE OF DISEASE = 0.01
 DISEASE INCIDENCE IN RH = 0.02
 LINEAR DOSE - RESPONSE
 MISCLASS. OF MARINE CONTROLS EXCLUDED

* INCORRECT POPULATION
 NUMERICS BASED ON
 ENVIRONMENTAL FATE
 OF TCDD

MORTALITY ANALYSIS

POWER COMPARISON OF THE RANCH HAND STUDY TO THE MARINE POPULATION CONSIDERING MISCLASSIFICATION AND RELATIVE EXPOSURE *

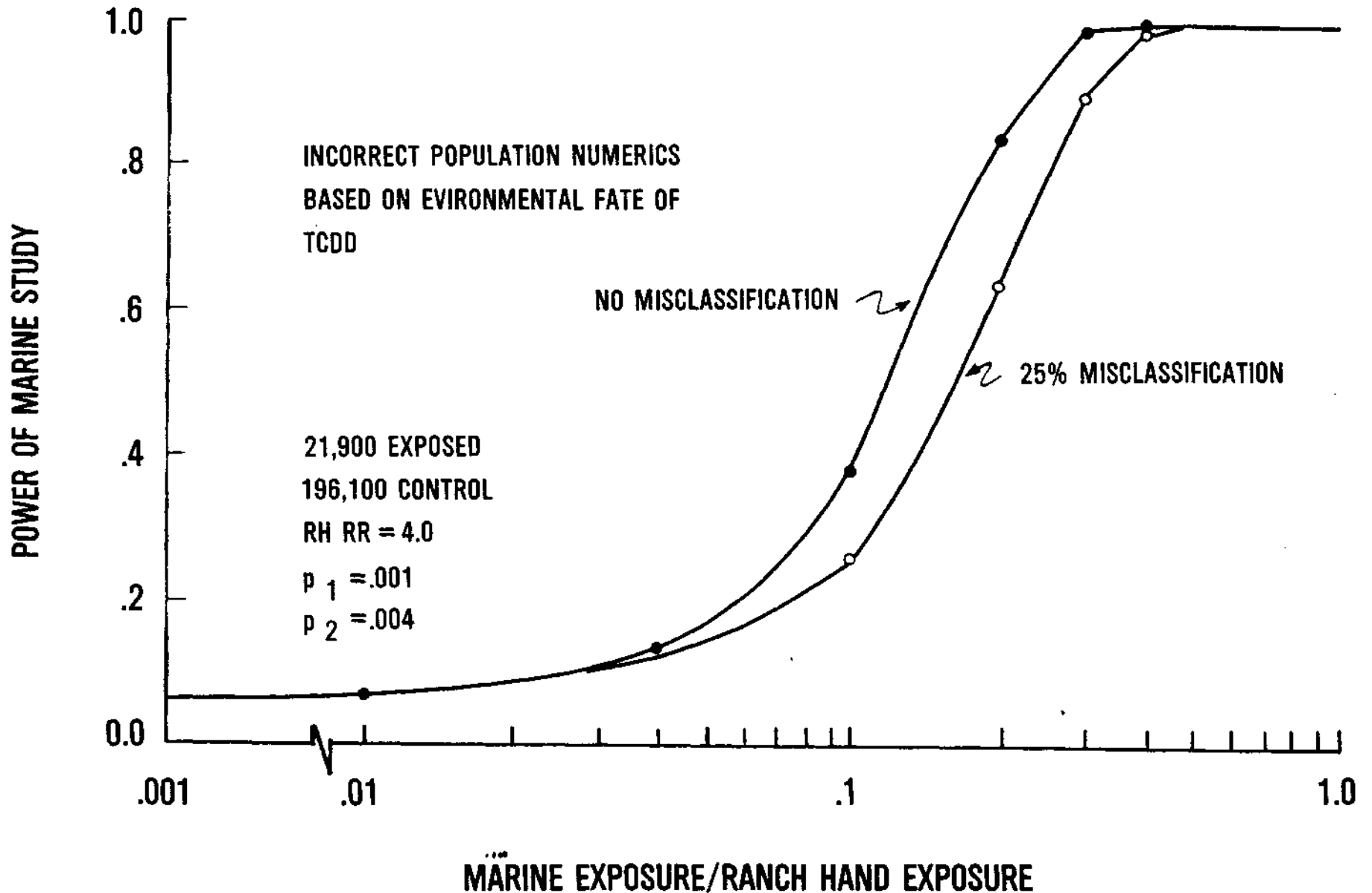
POWER TABLE

RANCH HAND POWER 1-B	% MISCLASSIFICATION	MARINE STUDY POWER			
		EXPOSURE LEVELS RELATIVE TO RANCH HAND			
		1/10	1/20	1/100	1/1000
.87	0	.38	.17	.07	.05
	10	.33	.15	.06	.05
	25	.26	.13	.06	.05

ASSUMPTIONS: RH STUDY POP. 1,200; 6,000 (1:5)
 MARINE STUDY POP. 21,900; 196,100
 NORMAL INCIDENCE OF DISEASE = 0.001
 DISEASE INCIDENCE IN RH = 0.004
 LINEAR DOSE - RESPONSE
 MISCLASS. OF MARINE CONTROLS EXCLUDED

* INCORRECT POPULATION NUMERICS BASED ON ENVIRONMENTAL FATE OF TCDD

POWER CURVES OF THE MARINE STUDY CONSIDERING RELATIVE EXPOSURE AND MISCLASSIFICATION OF THE STUDY POPULATION



CONCLUSIONS

RANCH HAND VERSUS OR PLUS THE MARINE POPULATION

- **OVERWHELMING ALLOCATION PROBLEMS FOR “EXPOSURE-NONEXPOSURE” IN MARINES**
 - **MISCLASSIFICATION BY GAO CRITERIA = DILUTIONAL EFFECT**
 - **ALLOCATION BY PERSONAL HISTORY = BIAS**
- **MARINE EXPOSURE 1/1000 OF RANCH HAND EXPOSURE**
- **MARINE - RANCH HAND POPULATIONS DIFFER BY HOST FACTORS; AGE, RACE, EDUCATIONAL LEVEL, ETC**
- **BY CONSIDERATION OF EXPOSURE DIFFERENTIAL AND MISCLASSIFICATION, RANCH HAND STUDY FAR MORE POWERFUL THAN INDEPENDENT MARINE STUDY OR ADDITIVE STUDY TO INCLUDE MARINES**
- **ADDITION OF MARINE POPULATION TO RANCH HAND POPULATION = UNACCEPTABLE SCIENCE**