

## 6. CONCLUSION

An evaluation of total and cause-specific mortality revealed no statistically significant differences between Ranch Hands and C1-C5 Comparisons or all Comparisons. The many non-cause specific analyses are summarized in Table 55, which displays the results of only the most fully adjusted one and two-sample analyses.

TABLE 55

### Non-cause Specific Summary

Odds Ratio (or SMR) and 95% Confidence Interval

Analysis	Ranch Hand versus C1-C5	Ranch Hand versus All Comp
Two-sample		
Logistic reg-discrete	1.00 (0.88, 1.14)	****
Logistic reg-continuous	1.00 (0.87, 1.14)	1.00 (0.88, 1.13)
One-sample SMR, adjusted		1.01 (0.80, 1.26)

None of the odds ratios, or the one-sample SMR, reported in Table 55 are statistically different from unity. The two-sample logistic regression analysis with continuous covariates was adjusted for rank, occupation, date of birth and tour start date, with date of birth and tour start date continuously distributed. The two-sample logistic regression analysis with discrete covariates was adjusted for rank, occupation, date of birth and tour start date, with date of birth dichotomized at 1 January 1935 and tour start date dichotomized at 2 October 1968. The one-sample SMR analysis was adjusted for rank, occupation, date of birth and calendar time in 5 year intervals, and survival time via person-years. Interactions were investigated in the one and two-sample analyses by including all pairwise covariate by covariate interactions in each model. Date of birth contributed significantly ( $P < 0.001$ ) to the fit of the model in all two-sample non-cause specific analyses.

In the single observed covariate by survival by group interaction, indicated with asterisks in Table 55, there was a significant group by survival by tour date (early, late) interaction due to a change in the group by survival odds ratio with levels of tour. Early tours were defined as those having a tour start date before 1 October 1968; late tours were defined as those starting after that date. For veterans with early tours, the adjusted odds ratio was 1.10 and the adjusted odds ratio for late tours was 0.93. This interaction was not detected in any of the other discrete or continuous adjusted analyses and indicates a reduced Ranch Hand risk of death in late tours and a slightly higher risk of death in early tours. Further, if tour is trichotomized, the interaction is not significant and the pattern of odds ratios is not suggestive of an exposure effect. This interaction remains unexplained at this time.

The adjusted cause specific analyses are summarized in Table 56. Only accidental, malignant neoplasm and circulatory deaths were numerous enough to permit adjusted analyses. None of the adjusted odds ratios shown in Table 56 are statistically different from unity.

TABLE 56

Adjusted Odds Ratio, Cause-specific Summary  
Ranch Hand versus C1-C5 and All Comparison

Accidental, Malignant Neoplasm and Circulatory Deaths

Cause	C1-C5		All Comparison		
	Two-sample		Two-sample	One-sample	
	Disc	Cont	Disc	Cont	
Accidental	1.02	1.02	1.05	1.05	1.16
Neoplasms, malignant	0.85	0.85	0.82	0.83	0.70
Circulatory system	1.07	1.07	1.06	1.05	1.09

The Ranch Hand digestive system death rate was significantly elevated relative to that of all Comparisons (unadjusted SMR = 2.7, P=0.01). However, 5 of the 6 Ranch Hand digestive system deaths were attributable to alcohol consumption and, therefore, this finding is considered unrelated to herbicide exposure.

Two statistically significant interactions reported in the 1984 update were also investigated with current data. The first, a group by survival by date of birth interaction, was not statistically significant in any analysis of Ranch Hands versus C1-C5 Comparison mortality or versus all Comparison mortality. A second interaction reported in the 1984 update, a significant group by survival-to-age-35 by rank interaction, remained statistically significant in Ranch Hand and C1-C5 mortality data and appears to be due to an excess of non-disease deaths in Ranch Hand officers under the age of 35. The observed number of such deaths in that cell is 7 and the expected number is 3. Of the seven deaths, 6 were accidental and one was a suicide. The same interaction was not statistically significant in the corresponding Ranch Hand versus all Comparison analysis or in similar analyses restricted to accidents. These patterns seem unrelated to herbicide exposure and are probably spurious.

Statistically significant increasing trends in the SMR, relative to the mortality experience of all Comparisons, during the years 1983 through 1987 were noted in flying officers, flyers, officers, and all personnel. The trends in flyers, officers and all personnel are attributed to the increasing trend among flying officers wherein the calendar year-specific SMR's were 0.00 in 1983, 0.59 in 1984, 0.69 in 1985, 2.80 in 1986 and 1.75 in 1987. This pattern is due to unusually low Ranch Hand death rates prior to 1986 and increased number of Ranch Hand circulatory and malignant neoplasms deaths during 1986 and 1987. However, Ranch Hand malignant neoplasm deaths in this stratum during 1986 and 1987 are not restricted to a particular anatomic site or morphology, as might be expected if dioxin was exerting a direct effect on malignant disease.

Additionally, current TCDD assay results suggest that flying officers were among the least exposed of all Ranch Hand personnel. These trends were not assessed relative to the Air Force exposure index due to data sparseness. Although they are not suggestive of a herbicide effect, these results remain unexplained at this time and emphasize the need for continued surveillance.

An analysis of Ranch Hand mortality versus dioxin exposure, as estimated by the Air Force exposure index, revealed no association between mortality and exposure.

In conclusion, the overall cumulative mortality of the Ranch Hands remains statistically indistinguishable from that of both their matched Comparisons and the entire Comparison population, although there is a statistically significant increasing trend in post-1983 death rates among Ranch Hand flying officers and a statistically significant increase in Ranch Hand digestive system deaths relative to the Comparison population; these findings are not suggestive of a herbicide effect. Ranch Hands are equivalent to all Comparisons in cumulative accidental, malignant neoplasm and circulatory system mortality.