Chapter 3

Community response with respect to the effects on daily lives

In the present project a questionnaire survey was conducted on the state of the damage to the daily lives in communities surrounding Kadena Air Base and Futenma Air Station.

3.1 Materials and methods

3.1.1 Questionnaire

The questionnaire consists of 98 questions including face sheet asking about the neighbourhood satisfaction, the regional and life environment, the base and aircraft noise and sleep disorders. The questionnaire is attached as Appendix A.

3.1.2 Methods

The questionnaire was distributed to 4,973 residents over 15 years of age around Kadena Air Base, 2,005 around Futenma Air Station and 916 as control in Shimajiri district, southernmost part of the island where aircraft noise exposure is scarce. The total sample size is 7,894. Figure 3.1 illustrates the communities, as indicated by solid small circles, where questionnaires were distributed in the map of middle and south parts of Okinawa Island.

The respondents were sampled from pole book by means of the stratified random sampling method with respect to WECPNL. The number of residents living in the area of the highest noise exposure with WECPNL over 95 is so limited that the questionnaire was distributed to all the residents over 15 years.

The distribution was done from November 1996 to January 1997 by means of the leave-and-pick-up method and the answers were collected from November 1996 to March 1997. The valid answers are selected on the following

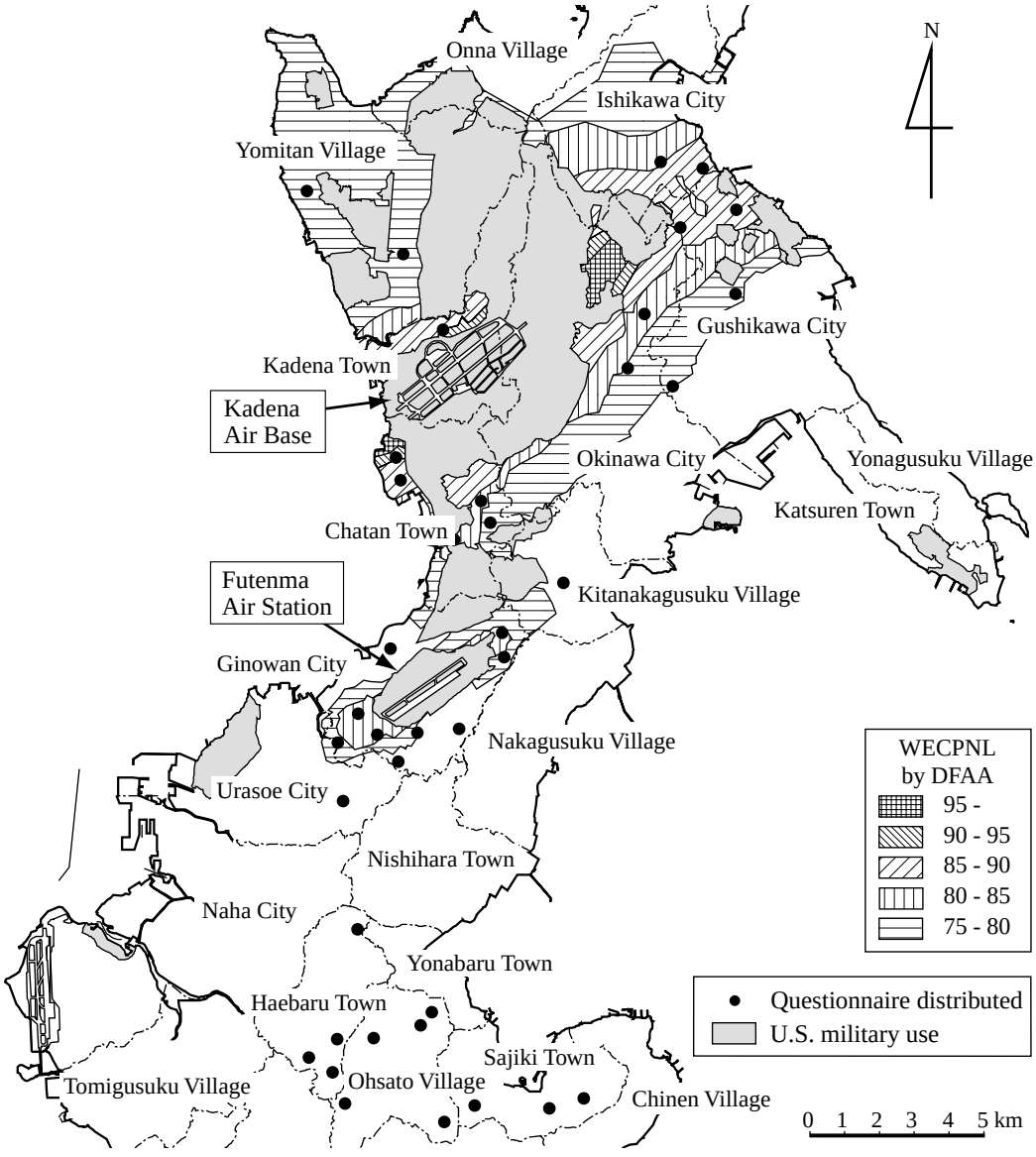


Figure 3.1 Investigated area around Kadena Air Base and Futenma Air Station.

Table 3.1 Number of distribution, answers, and valid answers

	Distribution	Answer	Valid answer	Rate of answer(%)	Rate of valid answer(%)
Kadena Air Base	4,973	3,961	3,560	79.7	71.6
Futenma Air Station	2,005	1,566	1,448	78.1	72.2
Control	916	794	685	86.7	74.8
Total	7,894	6,321	5,693	80.1	72.1

condition where in the individual answer respondent's age and sex are written as well as his or her address so as to identify the noise exposure in WECPNL and the respondent's age is 15 to 74 years. The number of valid answers obtained was 5,693. In Table 3.1 is shown the number of distribution, answers, and valid answers.

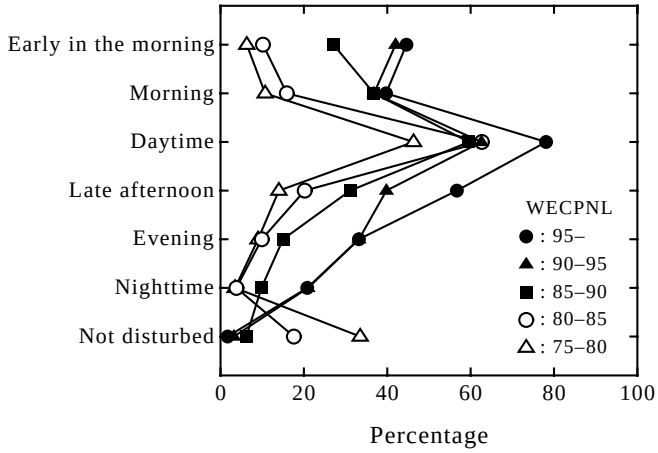
3.2 Results and discussions

3.2.1 Time in a day of disturbance and type of annoying noise

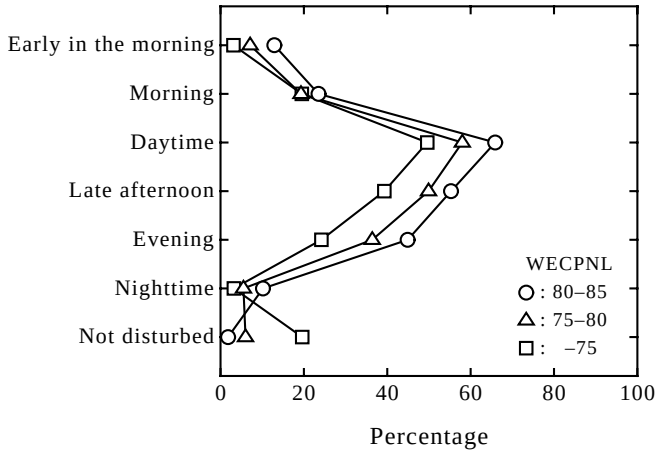
Answers to the questions (ref. Appendix A/ Question C5) asking about the time of a day when the residents are disturbed by the aircraft noise from the bases are analysed.

In Figure 3.2 are presented the time of a day the residents around Kadena Air Base (Figure 3.2(a)) and Futenma Air Station (Figure 3.2(b)) are disturbed much by the aircraft noise from the bases for the different levels of noise exposure. The most disturbing time is basically daytime as can be seen in the figure, but even in the midnight and very early in the morning over 40% of the subjects living in the areas of WECPNL of 90 and over 95 in the Kadena Air Base's surroundings complain disturbed.

In Figure 3.3 are plotted the percentage of the response on the type of the noises from the bases the respondents are particularly annoyed by (ref. Appendix A/ Question C6). The difference between the two airfields is shown in the rate of helicopter noise which about 60% of the population around Futenma Air Station report annoying, while those around Kadena Air Base report much less except in the area of WECPNL of 75. Around Kadena Air Base the noise is basically due to jet aircraft. As will be described below the difference of the type of aircraft used could be a factor of the difference in the response rates between the two airfields.

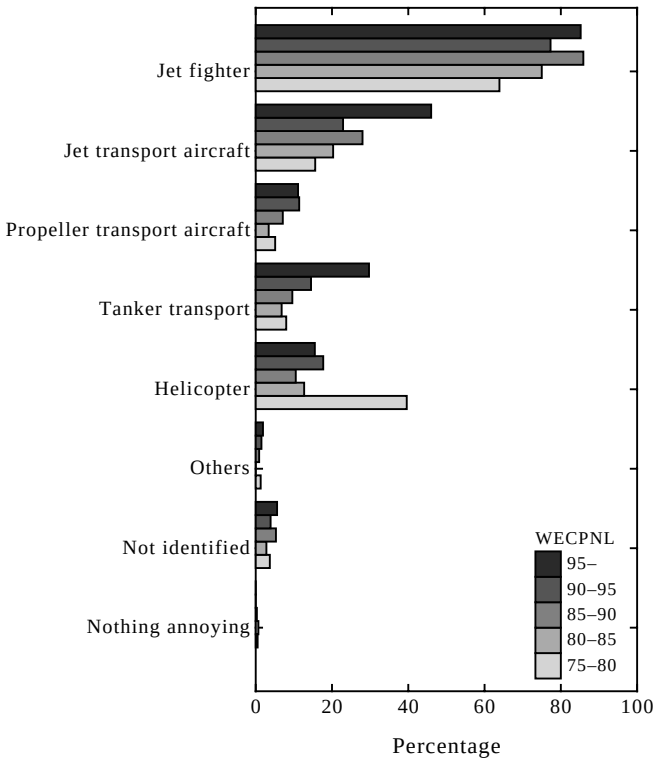


(a) Around Kadena Air Base.

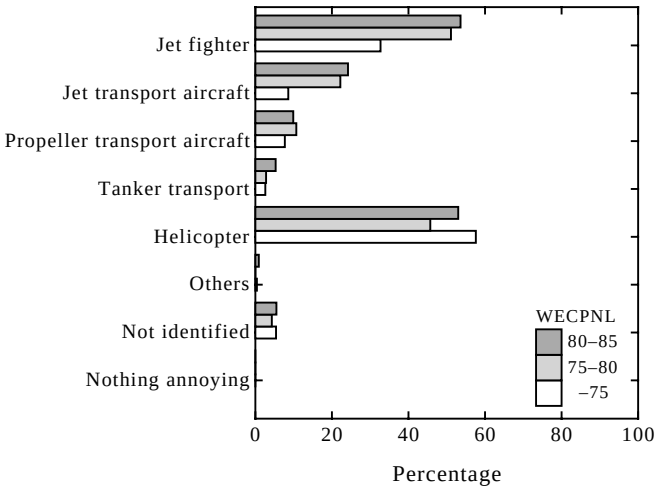


(b) Around Futenma Air Station.

Figure 3.2 Percentage of the response on the time of a day of disturbance in different WECPNL groups.



(a) Around Kadena Air Base.



(b) Around Futenma Air Station.

Figure 3.3 Percentage of the response on the type of the noises from the bases the respondents are particularly annoyed by.

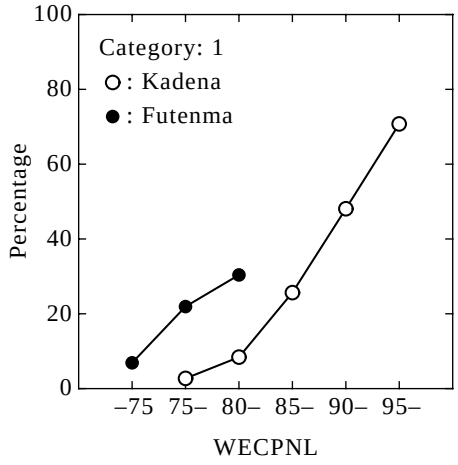


Figure 3.4 Percentage of the highly annoyed *vs.* WECPNL.

Category: "1. Very annoying."

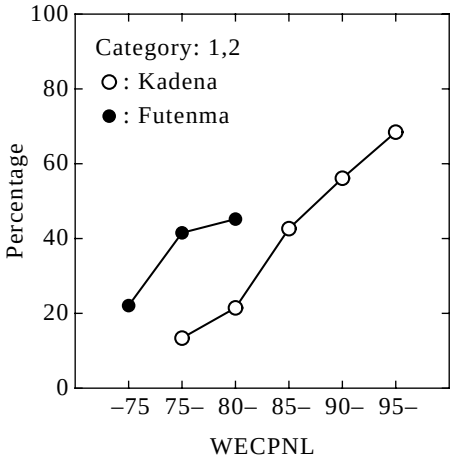
3.2.2 Annoyance and its related reactions and disturbance of daily activities

This section deals with annoyance reaction to the aircraft noise, its related reactions and disturbance of daily activities. The question as to annoyance is shown in Appendix A/ Question C1, and those of the related reactions and disturbance of daily activities are listed in Appendix A/ Question C4.

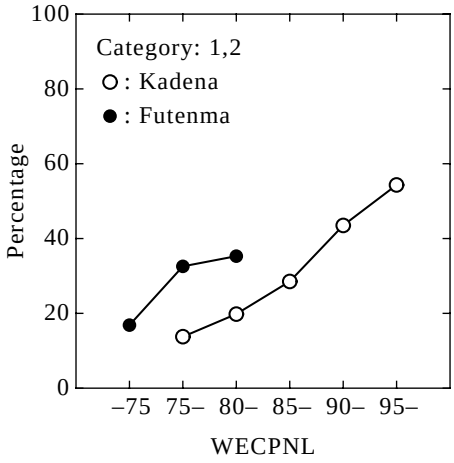
In Figure 3.4 is plotted the percentage of the highly annoyed as a function of WECPNL. Here "highly annoyed" response means answers marking "very annoying." In the figures open circles and solid ones indicate the percentages of residents around Futenma and Kadena airfields, respectively.

As can be seen in the figure, very clear dose-response relationships are found in the annoyance reaction. It is not surprising if one takes the questions and the wide range of the levels of aircraft noise exposure in the study area into account. The percentage of the "highly annoyed" starts increasing from the value of WECPNL of 75, gets higher as the level of noise exposure is high and reaches about 70% at WECPNL of over 95.

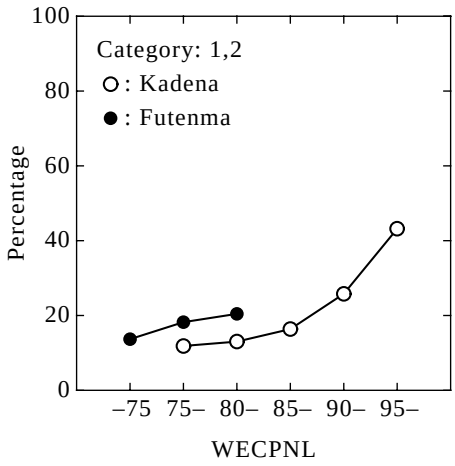
In Figure 3.5 are shown the annoyance related reactions such as "vexation (in local dialect)," "fear of aircraft noise" and "fear of the memory of war." The response is the answers to the alternatives of "1. always," and "2. often." In Figure 3.6 are shown other annoyance related reactions expressed as anxiety of aircraft crash, drop of objects, explosion and involvement in war. The trends of the dose-response relationships found in the figures are more or



(a) Vexation.



(b) Fear of aircraft noise.



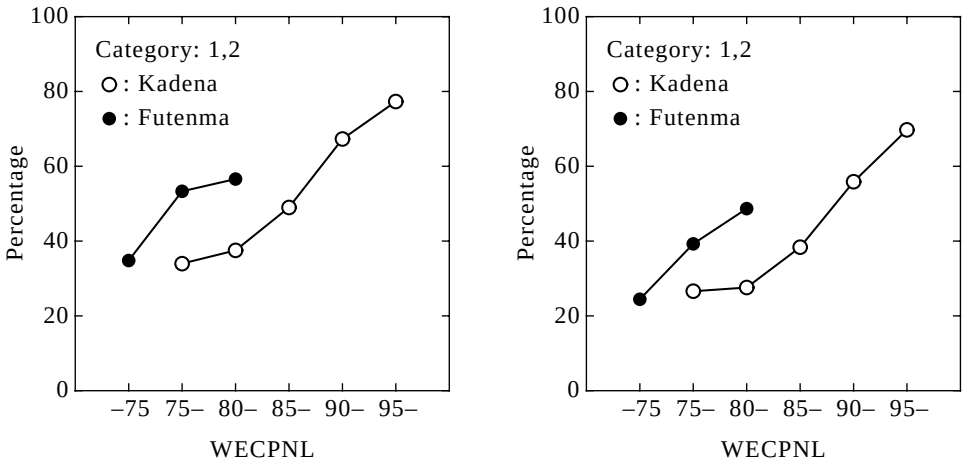
(c) Fear of the memory of war.

Figure 3.5 Percentage of the annoyance related reactions *vs.* WECPNL.

Category: "1. Always." "2. Often."

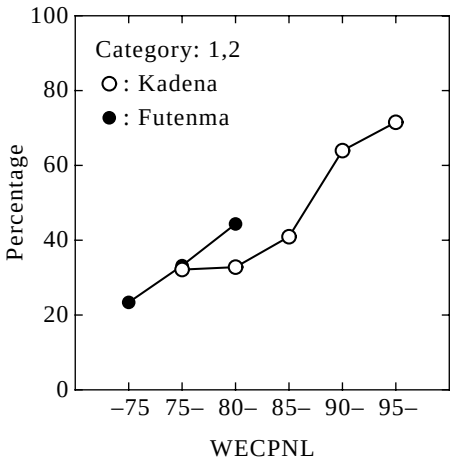
less the same as that of annoyance reaction.

The results shown in the figures manifest the prominent difference in the curves between the two airfields. Response of the residents around Futenma Air Station is higher as far as the present questionnaire items are concerned. If one shifts the curves of Futenma toward right by about 5 to 10 units of WECPNL, then they approximately lie upon the curves of Kadena. The cause of the difference, which is not small amount, is not very clear, but two theories

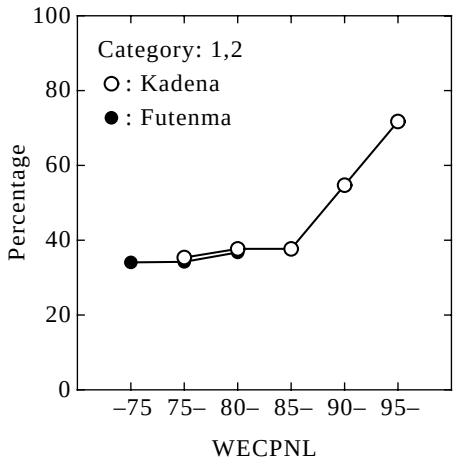


(a) Anxiety of aircraft crash.

(b) Anxiety of drop of objects.



(c) Anxiety of explosion.



(d) Anxiety of involvement in war.

Figure 3.6 Percentage of the annoyance related reactions annoyance expressed as anxiety *vs.* WECPNL.

Category: “1. Very much.” “ 2. Pretty much.”

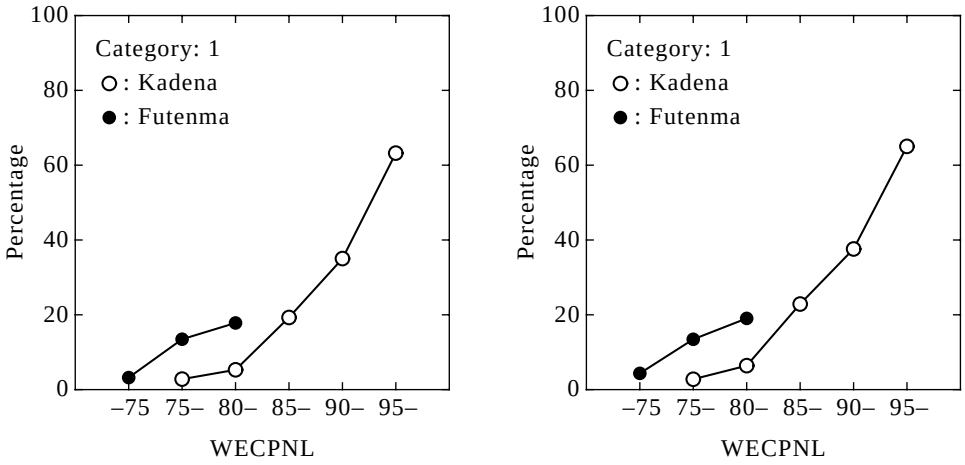
can be raised. (1) The values of WECPNL having been designated in 1978 by the DFAA do not represent the recent state of the noise exposure around the airfields. (2) As a rating scale, WECPNL does not apply to the variety of aircraft noise patterns. Although the question must be open to answer under the situation of lack of sufficient information, it should be pointed out that the Futenma Air Station, the U.S. Marines stations at, is used by helicopters much more than the Kadena U.S. Air Force Base. As a result, the noise around Futenma airfield is of comparatively low level with longer duration, which makes it difficult for the automated measurement devices installed around the airfield to identify aircraft noise from other environmental noises and thus results in missing to record the lower level of noise.

In Figure 3.7 are shown the responses regarding the interference with listening/communication. As is shown in the figure, the rates of the disturbed always in TV/radio listening, speech communication and telephone use increase as functions of WECPNL. The percentage of the respondents complaining their TV listening are disturbed by aircraft noise, for example, begins to increase at WECPNL of 70 or 75 and gets higher as the level of noise exposure increases reaching about 60% at WECPNL of over 95. The quite clear dose-response relationships between the rates and WECPNL are found as can be seen in the figure. In the areas where aircraft noise exposure expressed in WECPNL is from 90 to 95, the rate of the disturbed always is about 40%. In the areas where WECPNL is over 95, the rate of the disturbed always is over 60%. From the figure it can be said that in the vicinity of Kadena Air Base with WECPNL of 90 and 95, the residents find the interference with communication pretty serious due to aircraft noise.

In Figure 3.8 are shown the responses regarding the disturbance of daily activities and rest. The response rates regarding the disturbance of daily activities and rest are not high in the area with WECPNL below 85 but they increase with WECPNL in the region of over 90.

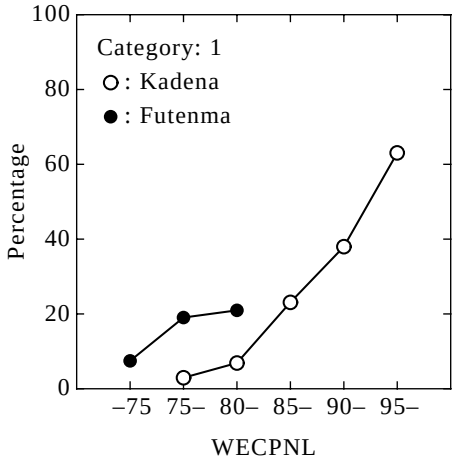
3.2.3 Sleep disorders

Answers regarding sleep disorders are analysed in relation to the level of noise exposure. The residents answered four questions regarding sleep disorders listed from Appendix A/ Questions D2 to D5. The questions did not specify the sleep disturbance as caused by the aircraft noise. A rating scale with five categories was prepared for these questions and the respondents were required to answer by putting a circle on one of five alternatives.



(a) Interference with conversation.

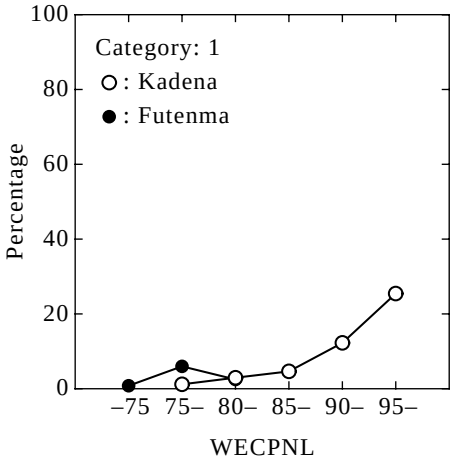
(b) Interference with telephone use.



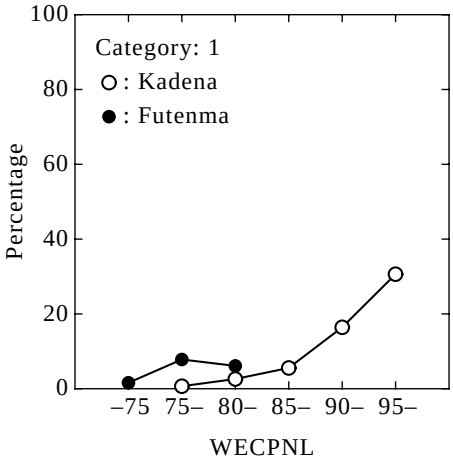
(c) Interference with listening to TV etc.

Figure 3.7 Percentage of the response regarding the interference with listening/communication *vs.* WECPNL.

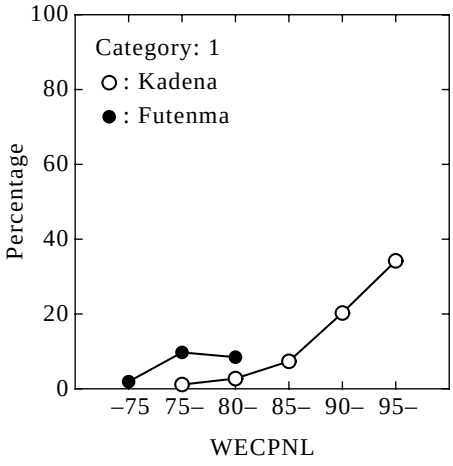
Category: "1. Always."



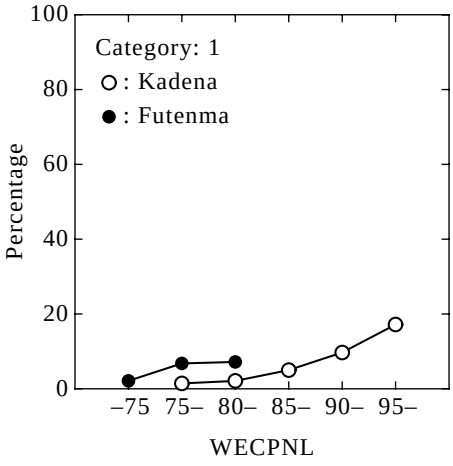
(a) Interference with work.



(b) Interruption of reading and thinking.



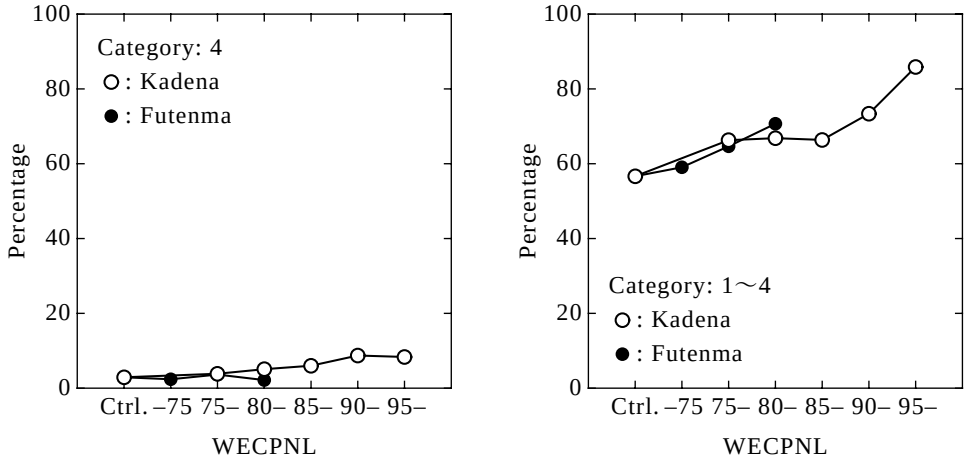
(c) Disturbance of rest.



(d) Interruption of watching TV.

Figure 3.8 Percentage of the response regarding the disturbance of daily activities and rest *vs.* WECPNL.

Category: "1. Always."



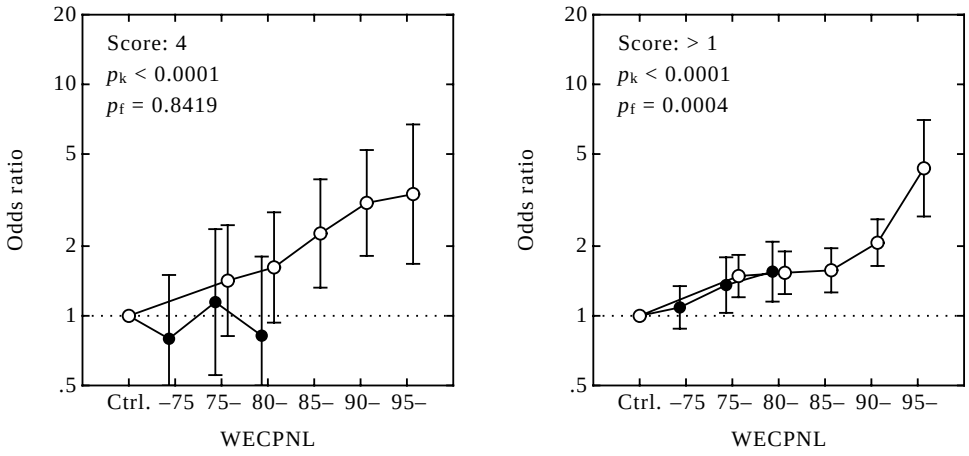
(a) Once or more a week: Score = 4 (b) Once or more a month: Score ≥ 1

Figure 3.9 Percentage of the scores on the sleep disorders *vs.* WECPNL.

Two types of scores indicating the degree of the sleep disorder are calculated based on the answers to the four questions as follows: The score "once or more a week" is the number of questions answered for the alternative 1 or 2; and the score "once or more a month" for 1, 2 or 3. Either score has the range from zero to four. It can be said that higher score indicates higher degree of sleep disorder.

In Figure 3.9 are shown the percentages of the scores on the sleep disorders as a function of noise exposure expressed in WECPNL and the control. Note the percentage is adjusted for the distribution of age and sex of the control. It is shown in the figures that the rate of the respondents with high score increases as WECPNL becomes higher, thus the clear dose-response relationships between the scores of sleep disorder and the level of noise exposure are found. It is also shown that about 60% of the control complain sleep disorder with the frequency of once or more a month, which suggests that people may have experience of sleep disorder to such a degree in general. This fact requires examining how the rate of sleep disorder among exposure groups increases in comparison with that of the control.

For this purpose, logistic regression model is applied with the independent variables of WECPNL, age, sex, occupation and the interaction of age and sex. In Figure 3.10 are shown the results of the analyses. The abscissa and ordinate of each figure indicate the noise exposure expressed in WECPNL and the odds ratio of the respondents, respectively. Vertical bars in the figures



(a) Once or more a week: Score = 4 (b) Once or more a month: Score $\geq$ 1

Figure 3.10 Odds ratio of the scores on the sleep disorders *vs.* WECPNL.

○ : Around Kadena Air Base. ● : Around Futenma Air Station.
p_k and p_f are the significance probabilities of trend test around Kadena Air Base and Futenma Air Station, respectively.

show the 95% confidence limits of odds ratios. In the figures p_k and p_f indicate the significance probabilities of trend test for Kadena Air Base and Futenma Air Station, respectively.

Clear dose-response relationships are found in all the figures, which are supported also by the result that the significance probability is less than 0.0001. The odds ratios of the group of highest noise exposure are 3.0 and 4.8 where that of the control group is one, so as to suggest that the residents exposed to high level of aircraft noise suffer from serious sleep disorder.

Lower odds ratio found in Figure 3.10(a) might be attributed to less frequent flights in the night time around Futenma Air Station than around Kadena Air Base as shown in Figure 3.2. Moreover, in the case of "once or more a month", significant differences from the odds ratio of the control are found even in lower exposed groups. These results imply that the sleep disorder of comparatively low degree occurs among residents even in areas of lower noise exposure.

3.2.4 Evaluation of the residential environment

Answers to the questions regarding the quality of residential environment evaluated by the residents are analysed in relation to the level of noise

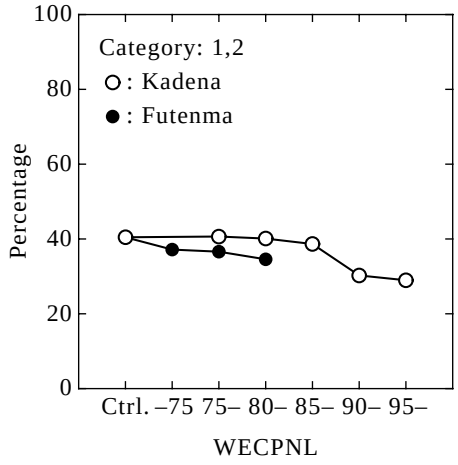


Figure 3.11 Percentage of the responses on the satisfaction with life *vs.* WECPNL.

Category: "1. Highly satisfied." "2. Satisfied."

exposure. The questions ask if they are satisfied with their life (ref. Appendix A/ Question A1), if they are happy with their place of residence (ref. Appendix A/ Question B1), if they intend to live at the present place permanently (ref. Appendix A/ Question B2).

In Figure 3.11 is shown the percentage of the responses on satisfaction with life for different levels of noise exposure expressed in WECPNL and of the control. Note that the response rate is adjusted so that every cell of age and sex matrix in each class of WECPNL has the same percentage of the respondents as the total respondents of the noise exposed areas. The percentages of the respondents who expressed their satisfaction with life by putting a circle on the answer item of 1 or 2 are about 40 in the control group and the noise exposed groups of WECPNL less than 90. However, the rate presents a sharp decrease to be about 30% for the noise exposed groups with WECPNL of 90 and over 95. Note that WECPNL 90– in the figure indicates the noise exposure is from 90 inclusive to 95 exclusive of WECPNL.

In Figures 3.12 is shown the percentage of the response to the question asking about the neighbourhood satisfaction. The rate of those finding their neighbourhood more or less satisfying (Figure 3.12(b)) is about 80% in the control group which decreases as the level of noise exposure is higher and becomes about 30 in the highest noise exposure group with WECPNL of 95. Clearly the rate of those who are dissatisfied with the neighbourhood increases with WECPNL.

The result of the logistic regression analysis regarding neighbourhood

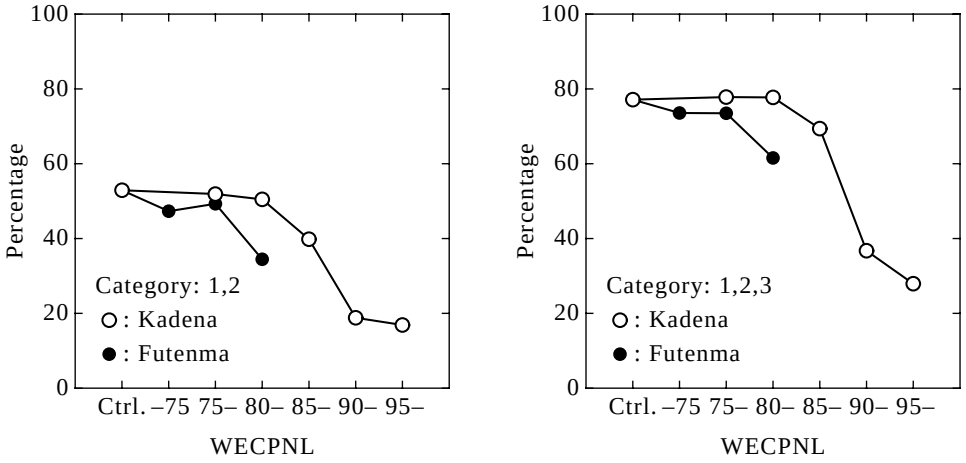


Figure 3.12 Percentage of the responses on the neighbourhood satisfaction *vs.* WECPNL.

(a) Category: "1. Very good to live in." "2. Good to live in."
(b) Category: "1. Very good to live in." "2. Good to live in." "3. Rather good to live in. "

satisfaction is presented in Figure 3.13. The figure illustrates clear dose-response relationship between the odds ratio regarding neighbourhood satisfaction and the level of noise exposure. The decreasing trend of odds ratio is highly significant with the significance level of 0.001 according to the trend test. It should be noted that the odds ratios of the groups with WECPNL of 90 and 95 are very low.

In Figure 3.14 is shown the percentage of the responses to the question asking about the intention of permanent residence. One can see from the figure that the rate of those having marked the answer item 1 decreases as the level of noise exposure increases. The percentage of those who marked the answer items 1 and 2 decreases in the areas with WECPNL 90 and over 95.

In Figure 3.15 is shown the result of logistic regression analysis regarding the intention of permanent residence. The odds ratio of the respondents who expressed their intention of permanent residence by marking the answer item 1 is plotted against WECPNL. Clear and linear dose-response relationship is shown in the figure. The odds ratio of the group of highest noise exposure is as low as about 0.3.

One can see from the figures that there exists a prominent difference in

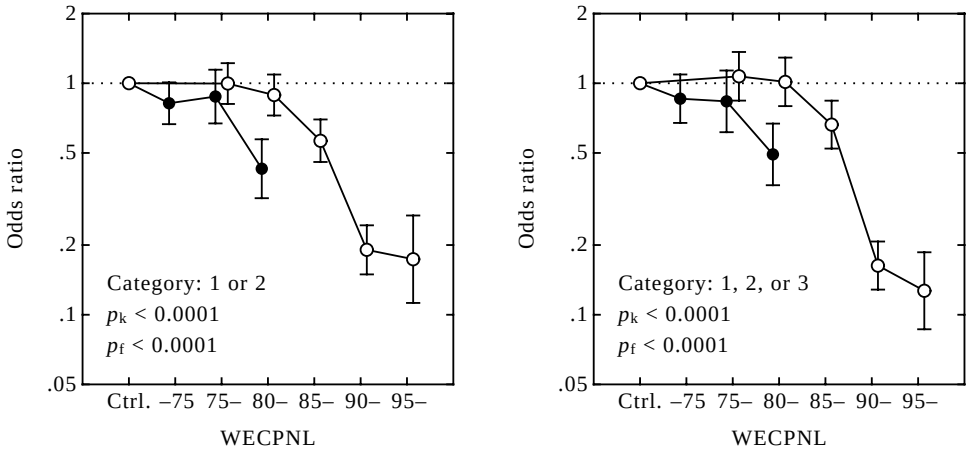
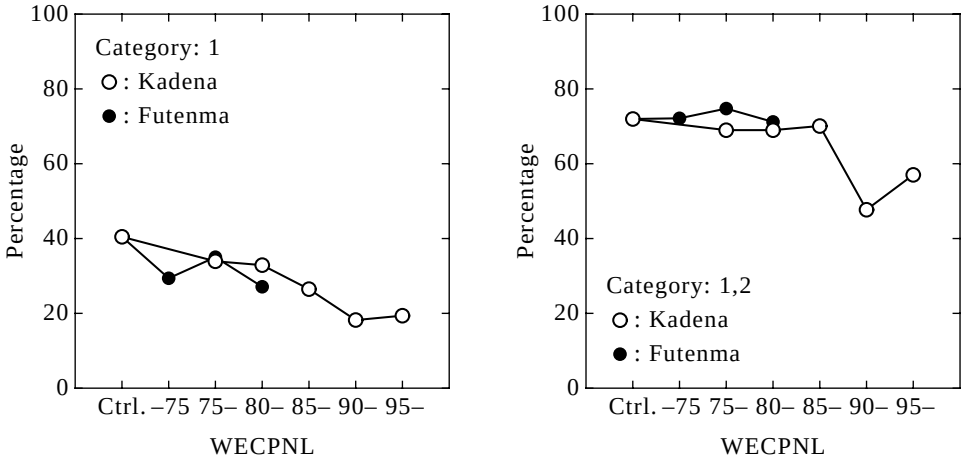


Figure 3.13 Odds ratio of the responses on the neighbourhood satisfaction *vs.* WECPNL.

○ : Around Kadena Air Base. ● : Around Futenma Air Station.
p_k and p_f are the significance probabilities of trend test around Kadena Air Base and Futenma Air Station, respectively.

(a) Category: "1. Very good to live in." "2. Good to live in."
(b) Category: "1. Very good to live in." "2. Good to live in." "3. Rather good to live in. "



(a) (b)

Figure 3.14 Percentage of the responses on the intention of permanent residence *vs.* WECPNL.

(a) Category: "1. I want to live here throughout my life."
(b) Category: "1. I want to live here throughout my life." "2. I do not want to move out particularly."

the residents' responses between the two bases. The reason of the difference is not very clear but the difference in the state and type of noise exposure could be a factor affecting the residents responses as was discussed in the section 3.2.2. Or one might find some other factors around Futenma Air Station that could give the residents' attitudes negative influence toward the neighbourhood satisfaction and judgement of the quality of area for residence.

From what has been discussed above it would be safe to say that the satisfaction with life reduces in the groups of WECPNL over 90, the neighbourhood satisfaction does in the groups of WECPNL over 85 and the intention of permanent residence does in the groups of WECPNL over 75. The reduction is very likely due to the aircraft noise exposure from Kadena Air Base and Futenma Air Station.

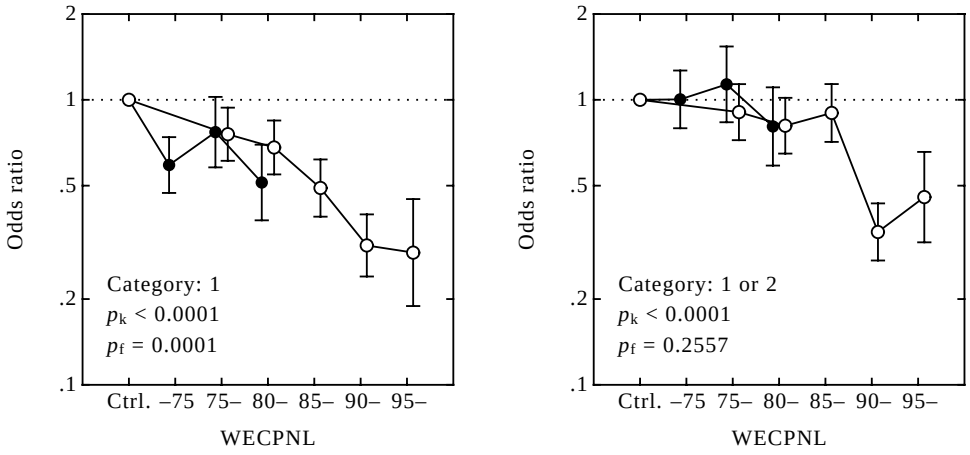


Figure 3.15 Odds ratio of the responses on the intention of permanent residence *vs.* WECPNL.

○ : Around Kadena Air Base. ● : Around Futenma Air Station.
p_k and p_f are the significance probabilities of trend test around Kadena Air Base and Futenma Air Station, respectively.

(a) Category: "1. I want to live here throughout my life."
(b) Category: "1. I want to live here throughout my life." "2. I do not want to move out particularly."