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Human Adaptation to Isolated and Confined Environments

Executive Summary

The study was conducted over a seven month period in a winter Antarctic isolated and confined environment (ICE). Physiological and psychological data was collected several times a week over the course of the winter. Information was collected on a monthly basis on behavior and the use of physical facilities.

Adaptation information indicates that there was a significant decrease in epinephrine and norepinephrine during the middle third of the winter. No significant changes were found for blood pressure over the seven months. Self reports of hostility and anxiety show a linear increase over the winter. There were no significant changes in depression over the seven months of the winter ICE. The physiological and psychological data do not move in a synchronous fashion over time. The data also suggest that both ambient qualities of an ICE and discrete social environmental events, such as the arrival of the summer crew, have an impact on the outcome measures used. It may be most appropriate to develop a model for ICE's that incorporates not only global chronic stressors common to all ICE's but also the role of discrete environmental effects which can minimize or enhance the influence of more chronic stressors. This information could be useful in programming ICE's.

Behavioral adjustment information highlight the importance of developing schedules which balance work and recreational activities. Anxiety levels increased with the percentage of work hours reported. The increase in work towards the end of the winter underscores the need to pace work loads

throughout the ICE tenure. Those individuals who reported the greatest variety of personal activities were the least depressed, hostile and anxious of the crew. This implies that ICE's should have a broad spectrum of outlets for personal activities.

The data on the use and modification of the built environment provide guidelines for the design of future ICE's:

** People brought similar items to make themselves feel at home including music, clothing, food, photography equipment, photographs of loved ones, and books. These types of items could either be included in the standard equipment found an ICE, or, in the case of the photographs, have a space provided in a private area to display them.

** Personalization of public and private areas was undertaken by everyone. This suggests the importance of providing materials that will allow people to change their environment to make it theirs. The personalization of ICE's helps people form attachments to the setting and to adjust.

** Flexible environments prove to be a significant factor in helping create novelty, new stimuli in a low stimulus environment. The participants in the study frequently rearranged those areas of the station with furniture and wall hangings that could be changed. Bedrooms with flexible furniture were the first chosen.

** The analysis of how the buildings were used indicates that areas which provide visual and auditory privacy should be provided. Sixty percent of waking hours were spent alone. Bedrooms were used extensively as places to obtain privacy.

** Information about where people socialized in large groups underscores the need to: locate these rooms near high traffic areas; remove them visually and in an auditory manner from private quarters; equip these areas with items

that facilitate socializing (e.g. music, food, game tables, videos, and comfortable and moveable furniture); and separate socializing areas that might have conflicting uses.

** Recreational areas where people can exercise or carry out physical activities are crucial to ICE's. The gym was in use from morning until evening. The majority of hobbies undertaken had physical or manual qualities. Future ICE's need not only facilities for exercise but outlets for projects involving physical activity.

Antarctic research stations during the winter season are analogous in several respects to the proposed space station. Both are located in physical environments that are hostile or lethal to human life. Both are located in settings that are remote from civilization. The external environment gives these settings the qualities of being isolated and confined. The isolated and confined environment (ICE) is an area of environmental stress that has received very little attention by United States investigators. These settings are theoretically interesting because they are characteristically low in sensory stimulation, yet confront inhabitants with a combination of physical and social stressors.

Between the late 1950's and the early 1970's there was a flurry of research conducted on ICE's such as Antarctic research stations, underwater habitats, and space vehicles. Little research has been conducted on this topic since then. Understanding the physical and psychological components of ICE's is important because many people are exposed to these settings. Naval submarines routinely go on 60 day patrols wherein outside communication is extremely limited. Oil companies employ professional divers who are required to remain in hyperbaric chambers for a month at a time. Research and business require the maintenance of isolated stations in both polar regions that can be isolated for 6 to 9 months at a time. NASA's proposed space station will confine and isolate its inhabitants for extended periods of time as well.

Much of the psychological research conducted in field ICE's has focused on group dynamics and changes in behavior (Oliver, 1979; Radloff & Helmreich, 1968; Earls, 1969; Johnston & Dietlein, 1977). Only a few field studies have examined the dynamic interactions between the physical environment and human behavior (Rivolier, 1973, Ogata, 1959; Ito, 1959). This study uses inhabitants of a winter Antarctic research station to examine human adaptation

to a natural, long-term ICE by measuring weekly physiological and psychological indicators of stress. The research examines the interplay between activities pursued and physiological and mood outcomes. Finally, the role of the built environment is explored by looking at how the ICE inhabitants use their buildings and import personal belongings to help make themselves feel at home and to make a successful adjustment to the ICE.

This introduction will define what makes an environment isolated and confined, and give an overview of previous ICE research that has been conducted in laboratory and field settings. The review of prior ICE studies will focus on the methodological strengths and limitations of those investigations as well as describing what has been learned about human behavior under these conditions. The intent of the research will be stated at the end of the introduction. The remainder of this report will describe the research in more detail.

Key Elements of an ICE

Isolated and confined environments have both a psychological and a physical side to their make up. Rasmussen (1973) points out that isolation is primarily a psychological concept in that the individual is separated from his or her social network. Isolation involves a reduction in sensory and social input (Zubeck, 1973). Haythorn (1973) suggests that as social organisms, human behavior is largely determined by interpersonal needs. When individuals are separated from their normal social network, abnormal behavior can occur (Suedfeld, 1974). Isolation can sometimes have a physical component when the isolation is imposed by geographical or other physical boundaries. However, it is the psychological response to the reduction in social and sensory stimuli that seems to generalize across situations in which individuals are

socially isolated. This occurs regardless of the physical or social variables responsible for the isolation (Rasmussen, 1973; Suedfeld. 1980).

Confinement is a salient physical dimension of ICE settings. In confined environment the mobility of an individual is restricted in some manner, usually because the amount of physical space is limited. The confinement element of an ICE is due, in most cases, to a harsh exterior environment that limits or prohibits activity outside of the built habitat. In the space lab it was the vacuum and extreme temperatures found in outer space that created a harsh exterior. Water pressure, lack of air, and cold temperature limit or prohibit outside activity in underwater habitats like submarines and SEALAB. In Antarctica, the harsh weather conditions, dangerous ice formations, and day/night cycles restrict movement outside buildings.

There are both physical and social aspects of the ICE that can combine to make it stressful to its inhabitants. While the people who live in these environments demonstrate the ability to adapt, there may be long-term costs to the human system of monitoring and coping with the threats that these factors represent (Lazarus & Folkman, 1984; Cohen, et al., 1986; Wohlwill, 1974). These long-term costs may result in environmental overload and subsequent physical and mental ill health (Cohen, et al., 1986). Behavior changes associated with stress have been recorded in ICE's and include: declines in alertness and mental functioning; slumps in motivation; increases in somatic complaints such as sleep disturbances, digestive problems, and symptoms of colds and flu; social withdrawal; self reports of depression and hostility; group splintering and polarizations; feelings of helplessness; and psychotic episodes (Suedfeld, 1974; Rasmussen, 1973; Oliver, 1979; Natani & Shurley, 1974; Edholm & Gunderson, 1973; Weybrew & Noddin, 1979). The physical and social factors that may cause stress in an ICE are reviewed below.

Physical Stressors

Physical sources of stress can include crowding, irregular or unnatural light cycles; changes in pressure; fluctuating and/or extreme temperatures; noise; poor air ventilation; sterile and monotonous surroundings; and the physical threat to the life of the exterior environment. Expense and the harsh environment often requires ICE habitats be small, leading to the crowded conditions commonly found in submarines, space vehicles, and some Antarctic research stations. The threat to life is a characteristic feature of the environment that surrounds the ICE. In Antarctica, harsh weather makes inhabitants dependent on imported buildings and supplies. The strict rules that govern personnel behavior outside of these buildings, and regular, mandatory patrols of the buildings that insure against fire and equipment breakdown, are reflections of the danger associated with the habitat (USARP Personnel Manuel, 1983). Temperatures may be extreme in ICE settings. The SEALAB had both the extreme cold of the water surrounding the submerged environment and the high temperatures found inside the hull. In other ICE's the high temperature may be external only, as in the case of the space shuttle. Subjects exposed to extreme temperatures have experienced both mood and physiological effects (Bell & Greene, 1982). Humidity may also be very high or low depending on how the ICE's built environment interfaces with the external environment and the requirements of the internal environment's air system. Humidity interacts with temperature and may increase thermal stress by reducing the efficiency with which the body maintains its core temperature (Bell & Greene, 1982). Irregular light cycles may disrupt inhabitants' circadian rhythms (Brown and Graeber, 1982). These irregular light cycles can occur because the day and night portions are exceedingly short, as experienced in space flight; or because day length is brief and nights are long (or vice

versa), as in polar settings; or because there is no natural light, as is the case for submarines.

Loud noise levels typically occur in ICE's with engines responsible for propulsion and/or life support systems (e.g., ships, submarines, space vehicles, the SEALAB, and Antarctic stations). There is extensive literature linking noise with increased levels of physiological and psychological stress (Cohen & Weinstein, 1982). Lack of fresh air is a problem with any ICE that is dependent on recycled air. This can lead to feelings of claustrophobia and a loss of control over the environment. Often these settings have a sterile quality due to the lack of personalization or lack of aesthetically pleasing materials. This sterile environment is often a result of the expense of importing these items to the ICE (e.g., Antarctic research stations and orbiting space habitats), and/or the space limitations and functional requirements of the environment (e.g., underwater and space habitats). Personalization may help the person feel at home and assist in the adaptation to their new environment (Vinsel, et al., 1980). Vinsel and her associates found that college students who decorated their dormitory rooms with items related to the college were less likely to drop out of school than students who decorated their rooms with mementos of home.

Very little research has been conducted on the effects of the physical environment on ICE inhabitants; Rivolier (1974a, 1974b) has conducted the only ICE research on the relationship between weather conditions in Antarctica and psychological and somatic disturbances. He found no relationship between outside temperature and resident's mood, buy did find an increase in psychological disturbances and somatic complaints on those days when weather conditions were rated best or worst. Rivolier felt that the meteorological environment has a direct impact on the psychological environment of the ICE.

Laboratory settings have been used to examine the effects of crowding in ICE's (Altman & Haythorn, 1967; Taylor, Wheeler & Altman, 1965; Haythorn, 1973). These studies found that territorial behavior becomes more pronounced in ICE's. They also observed that privacy has a modifying role in stress responses to crowding. These studies determined that in laboratory settings, subjects under ICE conditions reported more stress due to crowding than control subjects exposed to similar numbers of people in a specified space. Haythorn (1973) postulated that the stress experienced in crowded ICE's was due to the inability of ICE inhabitants to escape personal interaction. Crowding has not been specifically studied in natural ICE's, however, Radloff and Helmreich (1968) reported that the outcomes associated with crowded laboratory ICE's were not found under crowded conditions in the SEALAB. Radloff and Helmreich suggested that the laboratory findings did not generalize well to the natural setting because the laboratory did not provide similar intrinsic rewards.

Environmental stimulus reduction has been examined extensively in laboratory and field settings (reviewed by Suedfeld, 1980; and Zubeck, 1973). Results from these studies vary as a function of: (1) the degree of sensory deprivation; (2) the duration of stimulus reduction; (3) other mediating environmental variables such as the context of the setting; and (4) the cultural background of the subjects (Zubeck, 1973; Suedfeld, 1980). Laboratory research has found differences between control and stimulus deprived subjects on: (1) stimulus-seeking behavior; (2) biochemical and cardiovascular functioning; (3) task performance; (4) motor coordination; and (5) susceptibility to persuasion (Zubeck, 1973). Results from field studies are more complex to interpret because it is difficult to untangle effects due to stimulus reduction and those effects due to other stressors

associated with the setting (Suedfeld, 1980). To date, there has been no research conducted in naturalistic ICE's on the effects of stimulus reduction on adaptation to the setting.

Changes in light periodicity on human circadian rhythms has been studied more extensively in naturalistic ICE's than any other physical environmental factor. These studies have found that changes in day length result in changes in sleeping patterns, body temperature, mood, and biochemical rates of excretion (Ashina, 1973; Yoshimura, 1973; Simpson, et al., 1973; Lobban, 1973; Ito, 1959; ogata, 1959; Deryapa, et al., 1982; Moshkin, 1984; Topfer, 1980). To date, there have been no studies that have determined how changes in light cycles interact with other ICE stressors on human inhabitants.

There has been no other ICE research conducted on the role physical environmental factors may play in causing psychological and physiological stress. What conjectures there are about the part the ICE physical environment may play in causing stress has been inferred from research conducted in other settings. The meaning that these other settings (e.g., dormitories, prisons, hospitals, urban housing) may have for their inhabitants could be very different than the ICE has for its residents. These contextual differences may result in very dissimilar person-environment transactions. Altman (1973) has raised this issue in his call for a person-environment transactional model for ICE's.

Social Stressors

Most of the research that has been conducted on ICE's has focused on social stressors associated with these settings. Although an overview of this literature will be given later so that the methodological strengths and limitations of these studies can be placed into context with the research

described herein, it is important to introduce the types of social stressors experienced by ICE inhabitants.

The social stressors associated with an ICE include the loneliness of being separated from one's normal social network; a reduction in privacy; the necessity of forced interaction with other members of the ICE; dependence on a limited community of individuals for one's social needs with no control over who may be included in that group; and having little or no ability to help loved ones (who are outside or away from the ICE) with problems that may arise. These aspects of an ICE can lead to social withdrawal, feelings of helplessness, aggressive or depressed mood states, psychotic episodes, and changes in physiological levels of arousal (Suedfeld, 1974; Rasmussen, 1974; Oliver, 1979; Natani & Shurley, 1974; Edholm & Gunderson, 1973; Weybrew Y Noddin, 1979).

Positive Components of ICE's

Very little attention has been paid to the more positive aspects of the ICE. Suedfeld (1980) believes that environments characterized by reduced stimulation may have positive attributes if those settings are considered attractive by their inhabitants. He feels that cultural beliefs play a large role in whether reduced environmental stimulation is considered a positive aspect of a setting. Natani and Shurley (1974) noted that little attention has been given to favorable aspects of ICE's because negative affect and feelings are more readily identifiable and less elusive than positive affect and feelings. Oliver's 1979 Antarctic study followed up on anecdotal reports of positive regard for the ICE, increased self awareness, and personal growth after dwelling in ICE's. She found that scores on the Minnesota Multiphasic Personality Inventory's (MMPI) subscales for paranoia and schizophrenic qualities decreased over the course of the winter, while scores on scales

measuring self actualization and self acceptance increased. Ninety-three percent of the 39 subjects in her study reported a very positive experience. Other studies that questioned individuals about why they volunteer to spend time in an ICE find that ICE's encompass a number of desirable qualities including:

(1) receiving good pay;

(2) eating good food;

(3) experiencing an exciting environment that few have the opportunity to visit;

(4) getting relief from societal or familial demands, conflicts, and responsibilities;

(5) belonging to a special group of individuals who have the "right stuff" to be able to go to such a place;

(6) self-selecting to belong to a social group that shares common values;

(7) having work schedules that provide more free time (in some ICE's);

(8) living in an environment that moves at a slower pace without all the pressures found in most urban settings;

(9) having free time to focus on self growth and special projects

10) belonging to a community that may provide stronger social bonds and community-spirited activities than are typically found in the United States.

(Natani & Shurley, 1974; Oliver, 1977; Edholm & Gunderson, 1974; Rasmussen, 1973; Weybrew & Noddin, 1970; Harrison & Conners, 1984).

Overview of the Methodological Approaches Taken in Previous ICE Research

The major problem with previous research conducted on ICE's has been the methodological limitations of the studies. In the following section, the different approaches to ICE research will be discussed and their strengths and limitations described.

Laboratory Studies

Research on ICE's has taken two general forms, those studies done in laboratory settings, and those studies conducted in field situations. Laboratory studies have provided useful information about crowding effects, territoriality, group cohesion and conflict, sensory deprivation, and disruption of circadian rhythms (Taylor, Wheeler, & Altman, 1968; Altman, 1973; Haythorn, 1973; Zubeck, 1973; Brown & Graeber, 1982). Radloff and Helmreich (1968) have criticized ICE simulation studies because their results have not generalized well to natural ICE settings. There are a number of reasons why this may occur. Laboratory studies that are relatively brief in duration do not allow the gradual onset of stress that occurs in natural ICE's. Laboratory settings also do not provide the rewards associated with the exotic qualities of the natural ICE (Radloff & Helmreich, 1968). In addition, there are ethical limitations in inducing the level of stress in laboratory setting that might be found in the field ICE. It is also difficult to maintain such heightened levels of stress, necessary to model the ICE, in the lab. Finally, Radloff and Helmreich (1968) point out that laboratory studies use subjects who are more likely to volunteer for long-term natural ICE's.

Field Research

Anecdotal Reports

ICE research conducted in the field has taken three forms: anecdotal accounts; indirect, quantitative observations; and direct, quantitative observations. The majority of the studies have been anecdotal accounts drawn from diaries, logs, or evaluations by peers and supervisors. The biomedical research from the Skylab missions focused primarily on changes in bodily processes as a function of weightlessness. The only psychological data reported came from subjective overviews by the astronauts (Johnston & Dietlein, 1977). Research on environmental stress experienced by submariners has primarily drawn on officers' or ship physicians' personal observations (Earls, 1969, Kinsey, 1959). Antarctic research arose out of this tradition, drawing on the journals of the explorers and many of the early winter-over crews (law, 1960; Byrd, 1938; Siple, 1959; Wilson, 1966; Cherry-Garrard, 1922). The information drawn from these anecdotal accounts is most useful for developing a conceptual picture of the ICE experience. Themes and patterns can be derived for the construction of hypotheses for more quantitative studies. The weakness of such reports is their subjective perspective and unquantified conclusions.

Indirect, Quantitative Research

Indirect, quantitative research refers to studies that have been conducted by scientists who are not present in the field during their subjects' exposure to the ICE. The measures they use are quantitative in that they are measuring specific variables and testing hypotheses. Studies that use indirect quantitative observations base their findings on interviews of ICE inhabitants; questionnaires filled out before and after the experience, but rarely during the experience; medical and mental health reports; site

visits; and organizational records (Nelson, 1973). Weybrew and Noddin (1979) examined the mental health records of submariners relieved from duty to determine environmental and health factors contributing to personnel duty disqualification. They found that one of the primary causes for duty disqualification was maladaptive interpersonal relationships.

Most of the research conducted in Antarctica on human adaptation has been conducted in an indirect manner. These studies have focused primarily on uncovering personality factors that contribute to successful adaptation to the ICE, with the intent of developing selection criteria for ICE personnel (Gunderson, 1973a; Gunderson, 1973b; Gunderson, 1974; Smith & Jones, 1962; Nardini et al., 1962; Taylor, 1973; Crocq, Rivolier, & Cazas, 1973; McGuire & Tolchin, 1961). These investigators found that emotional stability, high task motivation, and social compatibility were the most important personality characteristics in predicting successful adaptation to the Antarctic ICE.

One of the strengths of the quantitative indirect observation methodology is the melding of anecdotal accounts drawn from interviews, and more quantitative measures. This allows one to develop hypotheses that can be tested and places quantitative data in context. However, important information about the ICE experience may be missed because quantitative data is only collected before, after and (at best) several times during the ICE tenure. Both the quantitative and qualitative data tends to be retrospective since the questionnaires and interviews ask the subject to recall experiences. This may result in selective and incomplete information being collected. An additional problem occurs when the scientists administering the study are perceived as outsiders who have not experienced the ICE and thus don't belong to the "club." or are perceived as having some influence over the subjects' future job opportunities. Under these situations the questionnaires

and interviews may contain information that is distorted and incomplete. A simple example of this problem is the alcohol consumption questionnaire that the U.S. Navy administers as part of its screening process for Antarctic personnel. Winter-over personnel from the year this study was conducted, as well as other years, reported lower levels of alcohol than they actually consume because they didn't want to be excluded from the Antarctic program. This kind of research may also miss the crucial dynamics taking place because the investigators either do not have first hand ICE experience, or because they are not present to adjust the instruments to fit what is taking place in the ICE.

Direct, Quantitative Research

This category of research refers to quantitative studies that have been conducted by investigators directly observing subjects under ICE conditions. Quantitative, direct observational studies of ICE's have been infrequent. Radloff and Helmreich (1968) conducted one of the most complete studies of this nature with the SEALAB underwater habitat. Using TV cameras, microphones and a battery of paper and pencil measures, these investigators were able to examine in detail, individual and group responses to a short-term, crowded underwater ICE. They observed that overall adjustment to the underwater habitat was good. They found strong cohesiveness among the aquanaut teams and very little evidence of interpersonal problems. They also concluded that the personality variable predicting successful adaptation to Antarctic ICE's (described above) were not significant predictors of who adjusted best to the SEALAB. In addition, Radloff and Helmreich found increased dependency on team leaders under ICE conditions. The only major methodological limitation of this study was that it only looked at a short-term exposure to an ICE. It is

possible that interpersonal friction and individual stress may have occurred if the aquanauts remained in the SEALAB for a greater duration.

Direct, quantitative research on the psychological adaptation to Antarctic ICE's has been very limited. Smith (1966) evaluated human adaptation and group interactions on a seven person traverse of the Antarctic Plateau during a summer expedition. He observed that group dynamics were structured around job responsibilities. Members of Smith's expedition also reported that if required to go on a future ICE venture, they would prefer to go with individuals in the group with whom they had had the least interactions.

An international expedition of researchers traveling in Antarctica during the summer season of 1980-81 kept records of human performance, perceived stress, and coping skills and compared those measures with control groups (Defayolle, et al., 1985; McCormick, et al., 1985). They found no differences on performance measures when compared with pre and post Antarctic measurements (Defayolle, et al., 1985). Self reports of stress were collected for both the Antarctic expedition members and a New Zealand control group. No differences were found between the New Zealand and Antarctic groups. Coping styles proved to be a good predictor of who reported higher levels of stress. Those subjects who were prone to repressing their personal needs as a style of coping reported less stress than did subjects who tended to accentuate the importance of personal comfort (McCormick, et al., 1985).

There have only been four psychological winter-over studies in Antarctica using direct, quantitative measures. Palmai (1963) conducted research which is probably the most comprehensive of this group. Using subjects at an Australian station, he took weekly audio recordings of group discussions for an hour after dinner; quarterly measures of group and individual social

preferences; and personal reactions and symptoms reported to the station medical officer. This data was evaluated for group dynamics and adaptation to the ICE. He found that individuals became more responsible about job performance as the year went on, but were less community-minded. Morale was found to be lowest in the third quarter of the year with increased levels of aggression and somatic complaints. Natani and Shurley (1974) asked winter-overs at South Pole station to record their leisure activity for a week every two months. Natani recorded personnel activities on a daily basis. These activities were evaluated on the basis of their adaptational value. The authors concluded that no changes in psychological adaptation were seen over the course of the winter. Oliver (1979) looked at psychological adjustment to the Antarctic ICE by asking winter-over members of McMurdo Station to fill out psychological adjustment scales three times during the winter months. She found a general increase in self awareness and mental health over the course of the winter. Research by McGuire and Tolchin (1961) evaluated group and individual adaptation at South Pole using paper and pencil measures, general observations, supervisor evaluations, and medical records. They reported that while overall group dynamics were positive, that some individuals were perceived by themselves and other members of the station as not being well accepted by the crew. The variables that best predicted who would fall into this "outsider" category were age (younger) and ranked ratings for successful adaptation by psychiatrists using pre-ICE interview transcripts.

A major drawback in conducting direct, quantitative research in ICE settings is that the members of the habitat object to being the subjects of such on-going research. This problem has been cited by Taylor and his associates (1985) and Rivolier (1973) as interfering with research protocol or causing studies to be terminated. There is a feeling that one is being

personally evaluated and placed under psychiatric scrutiny. This leaves individuals thinking that they cannot relax and be themselves.

The advantages of conducting quantitative research that is directed by an investigator in situ are numerous. These advantages include the objective nature of the data and the opportunity to make observations that can provide context for the objective data and ideas for complementary research. The addition or adjustment of measures to fit the dynamics of the specific ICE under examination is difficult to accomplish unless the investigator is present in the setting. Being a member of an ICE community under study also allows the investigator to compare self reports of behavior with observed behavior. Finally, because the investigator is a member of the community and shares its experiences, community involvement and commitment to the study is enhanced in quantitative, participant studies.

The direct, quantitative ICE studies that were reviewed above have been important because they provide a more complete, objective picture of group and individual adaptation than was available before. However, there have not been any studies conducted in long-term ICE's that have taken weekly physiological and psychological measures of stress. Most models of stress hypothesize that the stress response is both physiological and psychological in character (Cannon, 1932; Selye, 1956). Research that incorporates measurement of both psychological and physiological stress indicators can provide a more robust picture of the transactions between the individual and his or her environment. Those studies in the past that have taken both psychological and physiological measures in long-term ICE's, have taken them infrequently and may have missed important changes in stress levels. None of the field studies of ICE's have explored the role of the built environment in helping people make a successful adjustment to setting.

The research described in this report is unique because it attempts to address some of the short-comings of the research described above. It uses an Antarctic research station during the seven months of the winter to examine how individuals adapt and adjust to a natural, long-term ICE. It extends the information provided by previous studies by taking weekly measures of physiological and psychological stress indicators to determine patterns of adaptation to the long-term ICE. This research explores the part that behaviors of the inhabitants may play in helping them adjust to the ICE by comparing the types of activities performed by the subjects with individual profiles of physiological arousal and mood levels. The final portion of this study looks at how individuals modify and use their built environment to make it more "home-like." To this end an inventory was taken of the personal belongings brought by each of the ICE members to make themselves feel more at home, and an analysis of the functional use of rooms in the ICE over the course of the winter was conducted.

Human Adaptation to an Isolated and Confined Environment

This portion of the research examines the social and physical factors that modify human adaptation in an Antarctic research station during the winter season. The dependent variable in this study is stress. Stress refers to the responses that an individual makes to stimuli that threaten his or her systematic balance (Selye, 1956). These responses can be measured physiologically and through self report. This study uses multiple measures of stress to develop a robust picture of what individuals exposed to a long-term ICE are experiencing. The physiological measures used to quantify stress were blood pressure and urinary catecholamines. The Bipolar Profile of Mood States (POMS) (Lorr & McNair, 1984), a brief adjective checklist, was used as a self report measure of stress.

Those factors that were believed to mediate the level of stress experienced in this Antarctic ICE included: day length, weather, arrival of new people at the station, novelty of the situation, length of stay in the ICE, and special events occurring at the study site. Each of these factors interacts with the others to create an ICE setting that changes in quality over the course of the winter season. The role that each of these independent variables is thought to play will be discussed in more detail below.

There are tremendous changes in the number of hours that sunlight is present over the course of the austral winter in Antarctica. The shortest period of light experienced at the research setting during the winter was four hours of indirect light (the sun did not rise above the horizon) and the longest period of day length was 18 hours during late spring. Changes in light cycles have been shown to upset circadian rhythms and increase levels of

stress (Brown & Graeber, 1982; Ito, 1959; Ogata, 1959; Topfer, 1980; Deryapa et al., 1982; Moshkin, 1984).

The harsh weather conditions in Antarctica are thought to play a mediating role in stress outcomes because poor weather conditions can confine individuals indoors for extended periods of time. Strong winds are the major weather element that prevents people from going outside in those parts of Antarctica north of Antarctic Circle. Restriction of movement to the limited indoor environment has been associated with self reports of negative moods (Radloff & Helmreich, 1968; Harrison & Connors, 1984).

Novel settings are those in which the environmental stimuli are unfamiliar to the observers. These stimuli require more attentional focusing because their unknown processes are potentially threatening to subjects (Cohen, et al., 1986). Novel situations are often associated with increased physiological arousal (Baum, Singer & Baum, 1982). The initial novelty of being isolated and confined for seven months in Antarctica is hypothesized to have an impact on stress levels at the beginning of the ICE that will taper off as the setting loses its novelty.

The visits of new people at an Antarctic research station are major events during the winter months because of the infrequency with which they occur. New human contacts provide social stimuli that are alternatives to the limited interactions usually available, and as such, these visits are novel situations. The visits of females are particularly welcomed due to the overwhelming majority of males found in these ICE settings. It is suspected that the presence of new people at the study site will influence physiological and psychological outcomes.

Special events such as parties and holiday celebrations also add a bit of pleasant novelty in an otherwise very predictable environment. A lot of time,

effort, and planning goes into making these events take place. Such efforts include food preparation, the manufacturing of costumes or importation of formal attire, scavenging through station supplies for presents, unusual presentations, and room decorations. It is hypothesized that the effort elicited by the special events will have an effect on blood pressure, catecholamines, and mood.

Environments that are perceived to be stressful place a demand on individuals. Over time, the cost of adapting to that stressful situation is believed to manifest itself through physiological arousal and negative mood changes (Cohen, et al., 1986). For these reasons, length of stay in a long-term isolated and confined environment is expected to be associated with increases in blood pressure, catecholamines, and self reports of stress.

Methods

The research was conducted at Palmer Station, located on Anvers Island near the Antarctic peninsula at 64° 46'S, 64° 3'W. The station is located on a rocky peninsula on the glacier-covered island. The winter period extended from late April until the third week of November. During this period temperatures ranged between 19° and -17°C. The winds were often extreme. At one point during the winter the winds were in excess of 80 knots. Daylight occurred for as little as four hours during the month of June. The light reaching the station was indirect for the two months that the sun did not rise above the glacier.

Subjects: Nine of the inhabitants of Palmer Station, Antarctica, who wintered during the months between April and October, were the subjects for this research. Four of the subjects were scientists conducting winter research at the station. The remainder of the subjects were support personnel responsible for the day-to-day operations of the facility. All of the

subjects were males. Ages ranged between 26 and 43. Only one of the subjects had not attended college. Several of the subjects had previous experience in Antarctica (four), and three of those individuals had wintered-over previously.

Data Collection

Physiological Measures: Two measures were used to monitor changes in physiological arousal levels:

Blood pressure was measured two times a week over the six-month stay in Antarctica (see Table 1). Readings were taken between 5:00 p.m. and 6:30 p.m. to reduce error due to 24-hour cyclic changes in blood pressure. A sphygmomanometer was used to record blood pressure levels. Baseline measures were taken from physical examination records completed before the trip to Antarctica.

Urinary catecholamine samples were taken once a week for eight of the nine subjects. One chose not to participate in this aspect of the research. The catecholamine sample was taken on one of the two days that a subject's blood pressure was measured. It also coincided with one of the days that a subject filled out a POMS mood form (see Table 1 for an overview of the timing of all the measures used in the research). Subjects were asked to urinate in individual containers provided in their bathroom over an eight-hour period after the first morning's voiding. The urine bottle contained an anti-oxidant to prevent breakdown of the catecholamines. The samples were stored on ice during the sampling period. After the eight-hour collection, the urine volume was measured and a 10 ml portion was frozen at -70°F until assayed. A radioenzymatic assay was used to measure the amounts of epinephrine and norepinephrine in the urine (Durrett & Ziegler, 1980).

Self Report Measures

Mood change was measured using the Bipolar Profile of Mood States (POMS) (Lorr & McNair, 1984). This instrument contains a list of adjectives and asks the subject to rate how well each adjective describes his or her mood at that point in time. Embedded within the instrument are five bipolar subscales. Three of these subscales were used in this research. These subscales measured: degree of anxiety; level of hostility; and level of elation or depression. POMS has been validated and found reliable in a number of studies using college students, high school students, psychiatric inpatients, outpatients, and athletes (Lorr & McNair, 1984). Subjects were asked to fill out the POMS three times a week: one time between 6:00 a.m. and noon; one time between noon and 6:00 p.m.; and one time between 6:00 p.m. and midnight. The instrument was administered in this fashion so that moods associated with a particular portion of the waking hours would be sampled.

Environmental Measures

Weather records were collected three times a day by station personnel and included temperature, wind speed, wind direction, humidity, barometric pressure, and sky conditions.

Journal entries were made by the investigator. The entries contain information about events that took place at the station. Such events included visits from individuals not wintering over, parties, and external and internal incidents which may have influenced the arousal levels of individuals on station. These entries will be used to place quantitative data within the context of specific important events.

Procedures

The subjects were asked to participate in a study on adaptation to long-term isolation and confinement. They were given copies of a five-page

overview of the study and its goals that had been used as a grant proposal for NASA. The hypotheses in the NASA proposal were deleted from the handouts given to the subjects. Ten of twelve station residents participated in the research. Just prior to the study, subjects were asked to fill out a demographic questionnaire. During the six and a half months of the research they were asked to fill out the mood forms during certain hours three times a week. Participants had their blood pressure and 24-hour activities recorded before dinner on two of the same days they filled out mood forms. They also were asked to give an eight-hour urine sample once a week. This urine sample was taken on one of the same days that the subjects' mood, blood pressure, and 24-hour activities were recorded. At the end of the study the subjects were informed about the hypotheses of the study and asked for feedback about their participation in the research.

Results

Table 2 shows the group means of each month's physiology and psychological measures. This information is also presented in graphic form in Figures 1-3. These data were analyzed in an exploratory manner using repeated measures analyses of variance (ANOVA). The F statistic from these analyses should be interpreted with caution due to the small numbers of subjects in the study and the large number of dependent measures used. A more in-depth analysis using Box-Jenkins time series will be include in a future journal article. The length of stay in Antarctica was divided into three time periods. No significant effects of the length of stay in the ICE were found for systolic and diastolic blood pressure. Norepinephrine and epinephrine were significantly lower during the middle third of the tenure when compared to the first and third periods (norepinephrine, $F\ [1,8] = 13.01$, $p = .009$; epinephrine, $F\ [1,8] = 7.65$ $p = .028$).

Figure 3 presents the group means of the psychological self reports for each month. Significant effects of time were found for self reports of hostility and anxiety on the bipolar POMS scales but not for depression. Scores on the anxiety-composed scale declined over the three time periods which suggests that people became more anxious with time ($F [1,9] = 6.7$ $p = .032$). The subjects also reported that they felt more hostile and less agreeable over time ($F [1,9] = 7.11$ $p = .029$). The mean scores of the group for the three time periods used in the ANOVA's and the group means reported for each month in Table 1 all fall within one standard deviation of the normative scores for the POMS. This suggests that the study's participants, as a group, were not experiencing extreme mood levels at any time during the ICE period.

The relationships between the various physiological and psychological measures are shown in the correlation matrix in Table 3. Systolic and diastolic blood pressure were highly, positively correlated ($r = .62$, $n = 503$) as were norepinephrine and epinephrine levels ($r = .8873$, $n = 220$). However, blood pressure levels were not highly correlated with the catecholamine levels.

Systolic blood pressure was negatively correlated with measures of depression ($r = -.130$, $n = 485$), and anxiety ($r = -.103$, $n = 485$) on the POMS bipolar scales. The negative relationship between systolic blood pressure and anxiety is an anomaly perhaps best explained by the positive correlation between depression and anxiety ($r = .748$, $n = 719$). There are strong positive correlations between all three of the scales used from the POMS self report measure. Diastolic blood pressure was positively associated with hostile scores on the POMS scale ($r = .158$, $n = 485$). While all of the correlations reported between the blood pressure measures and self report measures were

statistically significant, it should be noted that all of these correlations were relatively low.

The physiological and psychological measures for the group were plotted over time. This information is presented in Figures 5-11. The records of social events and periods of high winds were tapped to identify those time periods during the winter isolation when change in the physiological and psychological indices could have been expected. Means for those time periods were calculated and are presented in Table 4 along with the overall means for these dependent measures for the whole winter period. The mean for those time periods when festivities were taking place at the station suggest that catecholamine levels were the only dependent measures which showed a major difference from the overall means for the winter. Festivities at the station included birthday parties, winter solstice, Halloween and other holiday celebrations. Journal entries which recorded self reports from the station members of depression and lethargy between the time of the first visit during the winter of the R/V Polar Duke (the National Science Foundation's research vessel) and the week after its second and final visit during the winter, led the investigators to believe that this time period would show lower physiological measure levels and increased negative psychological scores. Systolic blood pressure was slightly lower (119 mm Hg), as were the catecholamine levels (epinephrine, 791.6 ng/hr; norepinephrine, 3057 ng/hr). Psychological reports showed little change.

The arrival of the R/V Polar Duke with the summer crew marked an influx of new people, crowded station conditions, increased environmental stimuli, and what was perceived by many of the winter crew as an invasion of personal territory. Blood pressure values for this time period were elevated over the winter's means (systolic blood pressure, 126.5 mm Hg; diastolic blood

pressure, 84.5 mm Hg). Catecholamine levels were elevated as well (epinephrine, 997 ng/hr; norepinephrine, 4689 ng/hr). Depression scores remained virtually unchanged, but there were increased self reports of anxiety and hostility (anxiety, 20; hostility, 25.5).

High winds for periods of over a week, (which would restrict occupational, research, and recreational activity outside), were expected to have an influence on the physiological and psychological measures. No major differences were found between winter overall means and the dependent measures' mean levels for these time periods.

Discussion

The information on adaptation presented by the data collected in this study is complex. Systolic and diastolic blood pressure had a strong association with each other but not with the catecholamines. Both blood pressure and catecholamines are thought to be measures of the physical arousal experienced by a person. This lack of association may have been due to the difference in the time periods they are measuring. The catecholamines are a measure of an eight-hour period, while the blood pressure recordings are for a moment in time. Because blood pressure is so labile, the recordings taken in this study may not indicate an overall record of arousal levels for the day. Blood pressure, taken in this manner, may be sensitive only to short term, acute sources of stress. Measures of blood pressure over an eight-hour period using ambulatory blood pressure instruments might offer a parallel measure of arousal more closely aligned with the catecholamine measures used in this study.

Blood pressure levels did share some association with psychological self reports of mood. It makes sense that diastolic blood pressure levels would show a positive correlation with increases in hostility, and that systolic

blood pressure would do the same with elation (the opposite end of the continuum on the depression bipolar scale). However, it does not logically follow that systolic blood pressure would rise when people reported being more composed (the other end of the continuum on the anxiety bipolar scale). Several points should be noted here. First, while these correlations between blood pressure and mood are statistically significant, they are less than r = .16. Second, the high correlation between the POMS scales (see Table 3) implies that these may not be independent constructs that are measured by the psychological index but rather that all of the scales may tap a general negative or positive mood state.

None of the catecholamine measures showed a significant correlational relationship with the mood scores. This occurs despite the fact that all of the psychological and physiological measures are supposed to capture arousal levels which indicate stress. The catecholamines did show a very strong association with each other.

The lack of association between the various categories of measures is also reflected in the results of the repeated measures ANOVA's. Catecholamines reflected the pattern of adaptations suggested by Rohrer (1961). Rohrer proposed that the beginning and ends of the ICE tenure would demonstrate higher arousal than the middle period. The beginning period would reflect heightened anxiety, the second portion depression, and the third portion increased energy and aggression. The ANOVA's for the catecholamines show a significant depression of the catecholamines in the middle of the winter when compared with the beginning and end periods. However there is neither a significant linear or quadratic trend in the data for the blood pressure measures. Hostility levels do increase in a significant linear fashion over the winter as might be predicted by Rohrer's expectations about

aggression. The self reports of depression on the POMS did not increase during the middle of the winter as expected. Self reports of anxiety also increase in a linear fashion over time in contrast to Rohrer's hypotheses.

It may make more sense to examine the outcome measures in a less global, simplistic fashion. While there may be some general patterns of long term isolation, the data suggest that changes in outcome measures may be due to a compilation of effects that include chronic and acute stressors. In addition, the profile of outcomes for these various stressors may be different. The plots of the physiological and psychological data, and the means of those measure for various time periods on station that reflect unusual environmental conditions, allow us to look at the ICE experience in more detail. They also help in the initial stages of breaking out those environmental stimuli that have either chronic or acute impacts. What individuals experience in an ICE is not just a reflection of the isolated and confined qualities of those settings but rather how those qualities interact with the other environmental conditions that exist and events that occur. One might expect that being forced to interact with others in a social setting where no one is able to leave, would increase hostility over time. This pattern is reflected in the data. However, intervening events could change the pattern of hostility outcomes one might expect solely because of long term ICE tenure. Parties or special social occasions serve as such an event. People are able to interact with each other in a fashion that allow them to step away from day-to-day interactions and put a more playful, relaxed side forward. The outcome measures reflect both the notion of different profiles of outcomes in response to different environmental demands and the interaction between global effects of ICE's and immediate influences of specific events. Physiological measures of catecholamines for this time period are higher (even when these measures

include not just the time period during the festivities, but also the week of the parties), blood pressure is unchanged, and moods are more positive.

The higher physiological arousal indicated by the catecholamines may reflect the excitement of the special events. The psychological measures demonstrate a unique pattern as well, depression scores are slightly lower, as are anxiety and hostility scores. This pattern of outcomes reflect time periods that are scattered throughout the winter period implying the strength of discrete events' influence on the more global effects of the ICE.

In addition, the profile of outcomes for these events is different from those for other events. During the time when the summer ship brought in the summer crew and before the winter crew left, measures of blood pressure, catecholamines and psychological self reports of anxiety and hostility increased, while depression scores were only slightly lower. Two points to be emphasized here are, first, what people experience in an ICE is a result of both the qualities of isolation and confinement, and factors that are unique to the setting under examination. Second, measures of physiology and psychological self report respond in specific profiles depending on the nature of the environmental demands, and the meanings that those demands have for the individual.

What may be learned about adaptation from studies of ICE's are the general forces that impinge upon ICE residents and the impact of different classes of environmental stressors that may generalize across ICE settings. The data from this study needs to be teased apart in further analyses to separate out global effects of ICE's and their interaction with discrete events which occurred in this specific ICE. This study does offer some ideas about at least one event which may have an impact in all ICE's. The time period at the end of an ICE tenure when the exchange of crews is made appears

to be a very stressful time. The data from this study suggests that this is a very stressful time for the crew both physiologically and psychologically. Journal entries for this time period help to place this event in context. People reported that they felt invaded and overwhelmed by the new inhabitants. Work areas of the station that were set aside for individual winter crew use now had to be shared and turned over to new people. Sites that could be counted on as a place for solitary refuge were no longer available, both inside the building and out. The sheer number of people, and the increased social interaction that was required, was reported by several to be difficult to adjust to. In addition, the influx of new people required changes in the arrangement of the dining room and pub/lounge furniture, and more rigid rules for the use of these rooms. In general, the station took on a more institutional ambience. The sensitive nature of this time period is also reflected in the steps taken by incoming station management to ease the process. The summer crews were instructed to "take it easy" with the winter crew. Efforts were also made to minimize the time that the winter crew would remain at the station to train the new personnel before leaving for the United States. This time period of tenure in the long term ICE and the heightened stress experienced should be taken into account when planning future long term ICE's. Steps should be taken to minimize crowding and reduce the overlap of two crews in a station. Areas set aside during the ICE for the tenured crew for their private, individual use, should be maintained where possible. In general, efforts should be made to reduce the stress that occurs during this transition period.

Behavioral Adjustment to an Isolated and Confined Environment

This part of the research examines patterns of behavioral adjustment to a long term ICE and compares those behaviors with physiological and psychological outcome measures. Most psychological research in natural ICE's has focused on personality characteristics that are predictive of a successful adjustment (see reviews by Gunderson, 1973a, 1973b, 1974). This study treats behavior as a coping mechanism and looks at those patterns of activities that are associated with optimal levels of physiological arousal and mood. In addition, the research explores the sequence of behaviors over the course of the winter in order to provide information about programming needs of ICE inhabitants that might buffer the stressful effects of the ICE.

This section of the report will first define behavioral adjustment and review previous ICE field research on the topic. The discussion will then turn to coping and its role in the stress process. Finally, the part that activities may play in coping with an ICE will be considered.

Behavioral Adjustment

Wohlwill (1974, p 135) defines adjustment "as a change in behavior which has the effect of modifying the stimulus or stimulus conditions to which the individual is exposed." He draws a distinction between adjustment and adaptation. Wohlwill characterizes adaptation as a change in response, over time, to the same set of stimuli (1974, p 134). This study will focus on the behavioral adjustments that people make to reduce the stressful quality of the ICE.

Natani and Shurley (1974) conducted the only other study of behavioral adjustment to an Antarctic setting using records of personnel activities. They analyzed changes in activities over time and differences in choice of

leisure behaviors between subjects having different job responsibilities (Natani & Shurley, 1974). The investigators found no differences in behavior over time. Some differences in leisure behavior were found between the activities of the civilian scientists, Navy support crew, and Navy administrators. They did not collect any physiological or psychological measures of stress. This study seeks to add information about patterns of behavior and stress to that provided by Natani & Shurley's study.

Coping

Coping can be thought of as making adjustments to stressful settings. McGrath (1970, pg. 3) defines the coping process as "an array of covert and overt behavior patterns by which the organism can actively prevent, alleviate, or respond to stress-inducing circumstances." Lazarus and Folkman (1984) divide coping strategies into two types, emotion focused and problem focused. Problem focused coping techniques are typically an active attempt to change or terminate the stressor. Emotion focused coping strategies are more palliative and psychological in nature. This latter form of coping tries to reduce the impact of the stressor by ignoring it, changing its meaning, or through other cognitive techniques. Lazarus and Folkman's (1984) research on coping has found that most people use a combination of both strategies to deal with the stressors in their lives.

One of the problems with the paradigm of coping, as it has been used, is knowing where emotion focused coping ends and problem focused coping begins. it is easy to imagine a situation in which one may make a cognitive reappraisal of the environment (an emotion focused coping device) that results in active modification of the stressful environment (problem focused coping strategy). One of the major sources of stress in an ICE is the lack of variety in the stimuli present. A person could cognitively cope with the low

number of stimuli by restructuring and shifting downward what he or she considers to be a "stimulus rich" environment (adaptation). This same individual may then increase the number and variety of activities that he or she participates in as a result of this cognitive reappraisal. This change in activities will also alter perceptions of the environment by making the stimuli available more diverse and greater in number. Zubeck (1973) reports a similar form of this hypothetical coping response in a wide variety laboratory and natural ICE's. Individuals in laboratory and natural ICE's tend to seek increases in stimuli. The assumption is that individuals attempt to bring their environment back into balance by seeking an optimal mid-range of environmental stimuli.

In stressful environments, such as an ICE in Antarctica, it may be more useful to examine those behaviors that help individuals adjust to the setting. Little (1983, 1986) has devised an instrument that allows the investigator to evaluate dimensions of behavior and place them in context of their environmental, social, and temporal parameters. This instrument uses personal projects as units of analysis. Little defines a personal project as ". . .a set of interrelated acts extending over time, which is intended to maintain or attain a state of affairs foreseen by the individual." (1983, pg. 276). Personal projects are robust measures of behavior because they go beyond objective listings of behavior to include components of that behavior that are of interest to the investigator. Personal projects have been used by Little and his students to evaluate a broad variety of topics including professional burnout, social networks, and the change in activities of people across their lifespan (Little, 1986).

Stokols (1987), and Altman and Rogoff (1987) have emphasized the importance of looking at human behavior not merely as a response to

environmental stimuli but as an on-going transaction that takes place in the context of variables that have interacting temporal, geographical, and social domains. The present research examines behavioral adjustment to the chronic stressors of an ICE in a contextual fashion that incorporates temporal, environmental, physiological and psychological parameters. It permits a longitudinal assessment of the process of behavioral adjustment to ICE's.

In this study, work and leisure activities were recorded through monthly records of personal projects. The relationship between different types of behavior is examined and compared with the physiological outcomes. The amount of time spent on work versus personal activities is one of the parameters considered. The role that these two categories of behavior have on an individual's ability to adjust to ICE's may provide important information about how to program these settings.

Another parameter of behavior thought to be instrumental in adjustment was the level of social contact that the inhabitants had with each other. Were people most likely to spend time by themselves or with each other? When they spent time with each other, did they prefer to do so in large groups or in one-on-one situations? Data provided by this component of the study could prove useful in the design of ICE's to meet needs for social interaction and/or privacy.

The orientation of activities in the ICE setting might also play a significant role in behavioral adjustment to the ICE. Previous research on new college students has examined this issue in a different context. Vinsel and her associates (1980) conducted research on the personalization of college dormitory rooms. They found that college students whose rooms were decorated in themes reflecting their new college life versus their family home life, were more likely to remain in school than those students whose rooms were

decorated with a majority of items depicting their home life before college. Their research findings were generalized in this study to the nature of the activities pursued by ICE inhabitants. It was hypothesized that those subjects who participated in activities more oriented towards Antarctica than their life in he United States should exhibit levels of mood and physiological arousal that was more optimal than subjects whose activities were more oriented towards their life in the United States. Activities oriented towards Antarctica might include nature photography, skiing, and decorating the station for special events. Activities oriented towards home include letter writing, making gifts for family members, and calling home on the HAMM radio.

Methods

Subjects: The subjects for this part of the research were the same subjects described in the adaptation component of the study.

Data Collection:

Physiological Measures: The blood pressure and catecholamine measures described in the adaptation section of the research were used in this component of the study.

Self Report Measures:

Mood change was measured using the POMS bipolar adjective list described in the previous methods section. The mood sheets used for that aspect of the study were also used to examine the outcomes of different types of behavior adjustments.

Personal Projects: Once a month subjects were asked to list up to ten activities that they were involved in during the previous month (see Table 1). A modified version of Little's 1983 Personal Projects form was used for this purpose. These activities were then rated by the subjects along several dimensions including: whether it was for work or personal purposes;

amount of time spent on the project; how many others were involved in the project; whether it was oriented towards home or Antarctica; and where the activity took place on station. This measure will be used to evaluate whether there are particular types of activities that are more associated with successful adjustment to the physical environment of an ICE than others.

Procedures

The procedures used in this part of the study were the same procedures described for the human adaptation research. In addition to those procedures already described, the subjects were asked to fill out a Personal Projects form at the end of each month.

Results

Changes in behavior over the winter were examined by social level of contact, orientation of activities, and type of activities participated in. The monthly self reports of activities were categorized into activities for work purposes, personal goals, or projects that combined both work and personal factors. The percentage of hours each month spent by the group in these different kinds of activities is presented in Table 5 and Figure 12. The greatest percentage of hours spent on work projects were in May, July, and October. The percentage of time spent on personal activities fluctuated between 40% in June and 30% in September.

The orientation of projects was classified by study participants as directed toward Antarctica, home, or both locations. The change in the percentage of activities oriented toward Antarctica, home, or both is presented in Table 6 and Figure 13. Activities oriented towards Antarctica ranged between 54% in July and 76% in September. Project hours directed towards home ranged between 22% for July and November, and 5% in September.

Activities which couldn't be categorized as being for just Antarctica or just home, ranged between 8% in November and 25% in July.

The percentage of hours spent with different numbers of people is presented in Figure 14 and Table 7. Substantially more time was spent alone than with other people. It should be noted that the personal projects data does not include hours spent sleeping. In September the group reported that they spent as much as 68% of their time by themselves.

The least amount of time spent alone was in November, the same month that the station reopened for the summer. The percentage of time spent with just one other person grew from 2% in May to 14% in October, and then dropped again to 11% in November. The percentage of time spent with two other people fluctuated between 12% and 22%. The amount of time spent with three or more people was greatest at the beginning and end of the stay in Antarctica (May, 24%; November, 23%). During the other months, the percentage of time spent with three or more people fluctuated between 12% and 15%.

Correlations between the physiological and psychological measures and people's self reports of how they spent their time offer some interesting information (see Table 8). Decreases in diastolic blood pressure appears to be associated with the increase in the percentage of hours spent on activities oriented toward the subjects' homes in the United States ($r = -.33$, $n = 37$). It should be noted that the percentage of time spent on work that was oriented towards Antarctica represented 65% of that figure (see Table 9). In line with that information is the finding that self reports of anxiety is positively associated with increases in the percentage of time spent on work projects ($r = .346$, $n = 54$; $p = .01$). No other strong correlations were found between the outcome measures and the data on the personal projects forms.

Discussion

The purpose of this section of the research was to determine the relationship between behavior and successful adjustment to the long term ICE, and to look at patterns of behavior over time. The data indicates that increases in the percentage of hours spent on work was associated with increases in reports of anxiety. This indicates the importance of developing work schedules for ICE inhabitants that balance work and free time activities. This association in the data may reflect the increase in hours spent on the winter over work projects towards the end of the season. Members of the station were left on their own to decide their schedules for completing those projects. In some instances this resulted in disproportional amounts of time being spent on work in the beginning and ending months of the winter. One of the station crew members who demonstrated such behavior, indicated that he preferred to work under conditions in which weekly work goals were set out by station management so that work requirements were evenly paced over the winter.

The other element this data may reflect is the importance of incorporating free time into daily activity schedules. It is possible that those individuals who balance their work with a variety of recreational projects, may be able to step away from work and enjoy the unusual nature of the Antarctic ICE. These recreational activities may buffer the anxiety producing effects of the work. There is some basis for this idea. There was a high positive correlation between the number of personal activities listed and lower scores of depression ($r = .41$), hostility ($r = .44$), and anxiety ($r = .41$). The number of personal activities listed does not indicate the number of hours spent on the projects but may signify the degree of involvement an individual had with projects that were not work related. If

individuals were more absorbed by personal activities than work projects, this may have allowed them to separate themselves from work and thus reduced their feelings of anxiety.

One hypothesis of this study was that activities oriented towards Antarctica might reflect an individual's commitment and successful adjustment to the ICE. The data indicates that the percentage of hours spent on Antarctic projects is positively associated with increases in diastolic blood pressure. This is contrary to the hypothesis. A further examination of the data (see Table 9) finds that 65% of the projects oriented towards Antarctica were work related. It is possible that it is those Antarctic work projects that are driving the physiological response. Further analyses could tease apart the factors of the Antarctic projects which contribute to the rise in diastolic blood pressure.

The other information to be derived from the behavioral data is more descriptive in nature. In general, a greater percentage of hours were spent on Antarctic oriented behavior than behavior oriented towards home. Work projects reported accounted for a greater percentage of hours than personal activities. Time spent alone (not including sleep) represented the greatest percentage of hours when compared with time spent with one or more other people.

The patterns of behavior over time are not open to easy interpretation. Time spent with three or more people increased at the very beginning and end of the winter. This occurred for a variety of reasons. At the beginning of the winter people were forming a new community which required group efforts in both work and social settings. It can be thought of as a time when people were establishing work and social rules and procedures. At the end of the winter, in November, work projects had been completed and people were waiting

to return home. November represented a time where there were little work demands which is also reflected in the decrease of the percentage of time spent on work activities. With the reduction in work projects people had more time to socialize. It was also a time when the winter crew was getting ready to say good-bye to each other and there was a desire to spend time together as a group before it was no longer possible. In addition, the influx of the summer crew may have made it difficult to spend time in smaller groups, or even by one's self.

There was an increase in the time spent with one other person during the last two thirds of the winter ICE. This increase was probably due to the development of friendships that were strong enough that people would spend time in activities that incorporated just one other person.

The shift in the percentage of hours spent on work fluctuates in an unusual fashion. The high percentage of work hours in May could represent an initial push to get started on winter job projects. The decline in June is probably due to the week of festivities centering around June 21, winter solstice. During this time period very little work was done. From August through October the pattern that emerges is an increase of time spent on work to meet the end of winter deadline on job projects.

The percentage of hours spent on projects oriented towards Antarctica were high in May, decreasing over June and July and then increasing during the latter months of the winter. There are no clear explanations for this fluctuation pattern. While 65% of all Antarctic oriented projects were work related, the change in orientation does not follow the same pattern of change as job projects. Another interpretation would suggest that the decrease in day length which was most pronounced in June and July may have reduced people's ability to get outside and participate in outdoor, Antarctic oriented

projects. When one looks at the number of hours spent outside (see Table 9), over time there is indeed a reduction in hours, but it is for the first four months of the winter. Both May and August show low numbers of activities outside in contrast to the pattern seen in the orientation data. Clarification of why the Antarctic oriented projects hours fluctuated in the manner they did will have to wait for more in-depth analyses of this data and future research.

This data provides several findings that may be useful in the programming and design of ICE's. Most of these ideas have been touched upon in the discussion but will be summarized here. Schedules should be developed which balance work and recreational activities. The increase in work towards the latter part of the season underscores the need to pace the work load throughout the season. The end of the winter was the only deadline present in this ICE. Short term deadlines that would have broken up the final deadline into more manageable goals could have been useful for those unable to pace themselves.

This research also suggests variety in recreational activities may help individuals successfully adjust. It implies that ICE's should have a broad spectrum of personal outlets that can be carried out alone or with different numbers of other people. The findings in the section of this report on use and modification of the built environment provide further information about this topic.

The importance of providing people a place to be by themselves is indicated by the extensive number of hours spent in a solitary manner. Programming schedules for ICE's should take this need into account. The design implications of this need for solitude will be discussed in the next section of this report.

All of these results and their implications may provide guidelines for ICE programming that could improve the quality of life in an ICE.

Modification and Use of the Life Support Structures

Antarctic research stations and other ICE's are often sterile due to the lack of personalization, few aesthetically pleasing building materials, typically inflexible furnishings, and the general absence of a home-like ambience. Sterile conditions may be due to a number of factors. The cost of importing materials that may make the ICE more comfortable can be high. Design and safety constraints of ICE's like the space habitats or submarines may limit the aesthetic or flexible furnishings that can be used. The public nature of ICE's often require that crews only stay for a few weeks, months, or at most, several years. There is little opportunity to change the ICE to make it like home because a new crew can be expected to have to use it when the current staff is finished. Sometimes there may be rules about the changes that can or cannot be made. The use of the built environment is analyzed in this component of the research on adaptation to ICE's. The modification and utilization of the life support structures are examined in three ways in this report: (1) an inventory of personal items introduced to the setting by individuals, (2) personalization of private spaces and public spaces, (3) a functional analysis of the use of different rooms in the ICE. By understanding how individuals use and modify their ICE setting, we may be better able to design a long-term ICE that has spatial and psychological qualities which foster attachment and, thus, positive adaptation to the setting.

Inventory of Personal Belongings

The volume and nature of personal items brought to the Antarctic station provide useful data about what is necessary to make different people feel at home in an ICE. Individuals may differ in how well they can adjust to a new

physical setting based on what personal requirements they have. The individual who can load all their personal belongings into a backpack may develop a personal territory that is easier to establish and relocate than the person who may not feel they can establish a home territory without personal furniture, mementos, and other comforts.

This part of the study explores the nature of what people bring with them to the ICE and focuses on which items were considered by the majority of the subjects to be desirable in making them feel at home. Identification of items commonly considered important in a long term ICE is of great singificane to the design of ICE settings such as the proposed space station, or submarines, where the volume of personal items allowed is severely limited.

Personalization of Public and Private Spaces

Personalization of private and public space can offer information about attachments that people make to a setting as well as insights about how well they are able to adjust. Personalization can be accomplished through the modification of the environment (e.g. murals, framed photographs, wall paneling) or through the introduction of items brought from home (e.g. photographs of family, music, family mementos). Altman (1975) has suggested that the display of personal items is a form of human territorial behavior. Individuals may demarcate personal territory through such actions. Modification of the environment may indicate that an individual is making a commitment to a particular setting.

This part of the study determines whether the inhabitants of this winter ICE personalized their private and public areas.

Functional Analysis of Space Usage

Environmental evaluations of buildings are used to determine how well the structures accommodate the needs of the people who use them. Such an

evaluation can provide information to guide future modifications of present ICE structures and the design of future ICE's. In addition, an environmental evaluation can provide information about the impact of the physical environment on social behavior. This portion of the research uses a functional analysis of space usage in an Antarctic research station for both work and leisure activities. This analysis will determine which spaces are used at what times of the day, for what purposes, and by how many people. The physical qualities of those settings (lighting, furniture, equipment, color, building materials) will be examined to discover whether there are physical characteristics of the settings that are important in determining where and when certain behaviors take place.

Methods

Subjects: The same subjects were used in this section of the study as those used in the previous sections of the research.

Data Collection:

Physiological Measures: The blood pressure and catecholamine records used in the other parts of the study were also used as outcome measures for this section of the research.

Self Report Measures: The POMS adjective list described in the human adaptation component of this study was utilized as a dependent variable in this part of the research.

Inventory of personal belongings: Subjects were asked to list the personal items they brought with them to Antarctica that they felt were essential to make them feel at home. They were asked to give their own classification of what these personal items meant and why they brought them. The study's participants were requested to list things they wished they had brought but didn't. They were also asked to list those personal things they

brought but found they didn't need. This inventory was filled out at the beginning of the study, the fourth month, and on the return trip after the winter.

Personal Projects were also used in this portion of the study to determine where on station the different projects were conducted. This measure is described in more detail in the behavioral adjustment section. While these forms do not capture all of the behavior occurring at the station it does provide detailed information about the behaviors people considered most important, and where those behaviors took place.

Observational Measures

Photographic content analysis: Pictures and videos were taken of both private and public spaces over the course of the winter in Antarctica to determine what modifications were made to the building interiors to give them a more home-like ambience. Records were made of private rooms before they were modified for the winter, and after they were modified. Additional records of private spaces were made when changes occurred in their decorations or arrangements. Records of public spaces were made at the beginning of the winter and when changes occurred. These changes could either be permanent (murals) or temporary (party decorations).

Building interior maps: The interior of the station was mapped using a floor plan with furniture and lighting fixtures indicated. In addition, each room was inventoried and described on the basis of type of lighting; floor covering; wall and ceiling materials; colors used; wall hangings; types of furniture; furniture arrangement; and other types of equipment available in the room (stereo, gym equipment, VCR, books, etc.)

Journal: Entries in the journal for this section of the study described which individuals were involved with modifying the built environment.

Procedures

The protocol for collecting the dependent variables has been described in the procedure section of the human adaptation section of this report. To collect the additional data utilized in this part of the project, the subjects were asked for permission to video their rooms before they fixed them up for the winter. The investigator also requested to video the rooms after any new modifications were made to the room. Pictures were taken of the public spaces before the beginning of the winter and as temporary or permanent changes were made. The mapping of the building's interior was done at the end of the winter.

The subjects were also asked to fill out the personal inventory at the beginning, middle and end of the winter.

Results and Discussion

Personal Belongings Inventory

This portion of the study surveyed those items that people brought with them to feel at home. This information may be useful in designing long-term ICE's which would include those items considered instrumental in making those habitats have a more home-like ambience. It should be noted that these are not complete lists of the things that people brought to the setting. People only recorded those items which were important in making them feel at home. Of the nine people who answered this question, seven brought cassette tape players. All of the nine brought taped music. Two individuals indicated that they brought musical instruments to make them feel at home.

Food, such as teas, coffee, candy, and international specialties, were brought by six of the nine to make the station more home-like. One of these individuals brought a coffee grinder and expresso maker.

Clothing at the American Antarctic stations is issued by the National Science Foundation. Many individuals brought down special dressy clothes for the formal dinners on Saturday nights. They also brought down unique clothes so that they could look different from the other people in residence. Five of the nine people responding to the inventory indicated that they brought down clothing that would make them feel more at home.

Photography was an activity participated in by everyone on station. This was primarily still photography although shooting videos became a hobby for many people. Seven of the nine people brought photography equipment such as cameras, lens, and film to Antarctica to make themselves feel more at home. One individual brought down a video camera and VCR for this purpose.

Other hobby items were listed by seven individuals as things brought to the ICE to make them feel at home. These items ranged from crafts such as quilts, wood-working projects and juggling implements, to sports equipment such as skis.

There were a number of people who brought items down that helped them remember their family, friends and women friends. These articles were primarily photographs (5 of 9 people) but also included gifts (2 of 9 people).

Books were also brought by six of the nine respondents because they made these folks feel at home. Reference materials including computers, software, books, articles and corrrespondence courses were mentioned by six of the nine as being important in creating a homey ambience.

Some things that were idiosyncratic in nature were brought down for the feeling of home they provided. These include stuffed animals (2 of 9 people); flannel sheets (1 of 9 people); a waterbed (1 of 9 people); incense (1 of 9 people); and a slogan pin (1 of 9 people).

In an ICE where people will be staying for extended periods of time, it would be important to include both individual equipment for playing music and an extensive music library. Photography and other hobbies play an important role in making people feel comfortable in an ICE. Such a habitat should provide a variety of hobby related equipment that can serve as alternatives to work related tasks. It should be noted that a majority of the items listed as hobbies were physical activities either involving manual labor (wood working, juggling, sewing, etc.) or exercise (skis).

Having access to pleasure books was noted by two thirds of the respondents as having a significant role in making them feel at home. This was also noted by many in a question about what is important to include in a long-term ICE.

Five of the nine respondents indicated that having photographs of people they cared about made them feel more at home. Other people who did not bring photographs indicated that they would do so if they were to winter over again. It would be a good idea to include a space in individuals' private areas where they could display such photos.

The desire to have clothes to make one feel at home was mixed. Some individuals did not mind dressing like everyone else, while others liked to have a couple of unique items to wear. Most everyone liked having special clothes to wear for the Saturday formal dinners. The desire to dress up for Saturday dinners may have arisen out of a peer standard and wanting to fit in. Individuals who came to dinner on Saturday in their issued clothing were often teased. A type of group pressure to conform was at work in this regard. This is interesting in light of some people's desire to wear clothes at other times that could be identified as other than issued clothing. It would be a good idea to allow long-term ICE residents some input on their

individual choice of clothes. It may help provide novelty and an enhancement of individual identity.

The importance of good food in an ICE has been remarked on by numerous people. The food on submarines and in Antarctica is excellent in comparison with other institutional food. This interest in having favorite foods is highlighted by the number of individuals who brought such items.

Personalization

Personalization of bedrooms was undertaken by every individual in the study. People made new furniture; painted rooms; found posters to put up on the wall; brought furniture and stuffed animals from home; put up pictures of family or women friends; and decorated with memorabilia from past travels or home. Public areas were personalized in a temporary fashion for special events. People also made items to add to the station in a permanent fashion. One such item was the winter-over picture. The winter-over picture is taken every year to chronicle the winter-over crews down through the years. People also took photographs and hung them in public areas. One individual made a plaque to go up in the pub while another individual painted birds on the doors of the bedrooms in the biology building. The over-all impression was that people added to their public and private spaces in order to make the place more their own. The fact that everyone was involved in personalizing at least their own room suggests the importance of being able to do this in a long-term ICE.

We believe that designers of ICE's should keep in mind that while an ICE is often constructed as a work setting, as a technological means to meet various scientific or commerical objections, the ICE has a dual function for the residents. It is their work space, but it is also their community. They use it and think of it in that way.

Use of the Physical Facilities

This section of the report will integrate the results from the personal projects and questionnaire data on the use of the physical facilities. This data will be coupled with descriptions of the physical facilities and floor plans to present a picture of how an ICE is used.

The total number of hours reported on the personal projects form for the isolation period was 17,136 hours (see Table 9). This figure did not include hours required for sleeping, and in most instances, did not reflect hours spent at meals. Activities that were solely for work purposes represented 52% of the total hours reported. Activities which were for personal goals only, represent 34% of the project hours recorded. The projects that involved both work and personal objectives were reported for 14% of all the activities recorded.

Of the 17,136 hours reported, 10,294 hours (60%) were spent on projects which were conducted alone. Seven percent of the projects (1,156 hours) were participated in with one other person. Activities which involved two other people accounted for 2,832 hours or 17% of the total hours recorded. Those activities which included three or more people took 2,798 hours or 16% of the total hours reported.

The station is made up of two major buildings and several smaller buildings (see floor plans in Figures 15-17). The biology building is made up of three floors. The first floor contains laboratories, various workshops and the dispensary. The second floor is made up of the dining room, cooking and food storage facilities, a biological supply room, communication facilities, and offices for the facility managers. The third floor is devoted to bedrooms, a laundry and bathrooms. GWR (Garage, Warehouse, and Recreation) is a two-story building. The first floor contains the garage for servicing the

heavy equipment (forklift, loader, snowplow, etc.), the power plant, and storage rooms. The second floor contains the gym, storage rooms, the station store, the library, the pub/lounge area, bedrooms, and a men's bathroom. There is also an observation deck located on top of the building.

The pub/lounge is a large room that has two functional areas that spill over into one another. This room is lit by incandescent fixtures, and has a cathedral ceiling. The room has a light yellow linoleum floor. The bar area is carpeted in brown carpet. The bar is separated from a video area and pool table by a wall extending one half of the way across the room, and by the change in flooring material. The walls behind the bar are paneled with cedar. The bar itself is curved and made of wood with a formica surface. There are six stools at the bar. It was possible to gather the whole winter crew around the bar. The wall behind the bar is hung with memorabilia from previous years. These items include photographs, an engine prop, and various plaques. Personnel stored their alcohol and non-alcoholic refreshments in a refrigerator adjacent to the bar or on a shelf behind the bar. There was also a sink behind the bar. The pub area had a very good stereo and cassette player. This was an area utilized most every night to gather and talk, listen to music, eat popcorn, and share drinks. In front of the bar was a "fooze ball" table which was heavily used. Memorabilia is also found on the wall opposite the bar. Two whale rib bones are hung from the ceiling in an arch and help to separate the pub from the rest of the lounge.

That area of the pub/lounge floored in linoleum contains a table which can be used for pool or ping-pong, and an area used to watch videos. The video side of this part of the room has shelves on three walls with video cassettes, two VCR's, a TV, and books. There are two windows that look out towards the mountains on the Antarctic peninsula. There are two couches and

four easy chairs in this area. This furniture was constantly being rearranged by the individuals assigned to clean the area each week. People seemed to enjoy making the room look different. On the pool table side of this part of the room, the wall separating the bar from the lounge is painted light yellow and the other two walls are paneled with plywood backed wood. There is also a frequently used dart board on the wall between the bar and the pool table. In the evenings after dinner most of the crew would come up to the lounge and watch a science fiction series which had been taped by one of the personnel. A video movie was then chosen and watched. After the movie, those people who wished to sit at the bar and play music, and/or play games (pool, darts, ping-pong, etc.) had priority. This room was also used during the day for socializing and work. When the HAMM radio was being used to make phone patches, people would wait for their turn by watching prerecorded music videos.

People reported on the personal projects forms that a total of 1,536 hours were spent in the pub/lounge. This figure represents 9% of the total hours reported for the station (see Table 10). Of these hours, 1,398 (91%) were spent in activities oriented towards Antarctica. No work hours were reported for this room, however 89% of the time spent in the room was for personal activities. Projects in the pub/lounge were primarily carried out with three or more people (55%, 82 hours). Activities by single individuals were reported for 36% of the time spent in this area. It is most likely that this type of activity involved watching movies or reading.

The gym is a large, high ceiling room with painted metal walls that have murals on them. The floor is also metal but has been covered in some areas by rugs. The lighting is incandescent. The room is L shaped. One of its wings is taken up by a large water tank used in case of fire. The other wing

contains exercise equipment including free weights; a bicycling machine; a rowing machine; a bench for lifting weights; and a rack for holding the free weights. There is also a cabinet which holds a stereo, a cassette player, a VCR, and a television. The exercycle is often positioned towards the TV or facing towards the windows that line one side of the room. This room was heavily utilized from 6:00 a.m. to 10:00 p.m. All of the personnel used the gym at some point during the year. Four of the personnel used it on a daily basis. Typically people liked to work out by themselves, but there were several sets of people that would exercise together. Music was usually played during exercise. Sometimes people would put on a video, especially when they used the exercycle.

The information reported on the personal projects forms about the use of the room indicates that the gym was used for a total of 716 hours, 4.2% of all the hours reported for the entire station (see Table 10). Personal activities represented 73% of the hours recorded for the gym. These personal activities represent 9% of the total personal activities reported for the winter isolation. The projects in the gym were conducted primarily alone (592 hours, 83%) although 17% of the time activities included one other person.

The HAMM "shack" was a room that contained the HAMM radio used by personnel to call family and friends. It is a small narrow room with the radio at one end with a chair. It has a bulletin board on one wall and a chalk board on the other. The floor is white tile linoleum. The ceiling is acoustic and there is incandescent lighting. Once a day this room was used for an hour or two for making phone patches to the United States. It is too small for more than two to three people to fit in.

The activities reported on the personal projects forms for the HAMM shack totaled 134 hours, or .8% of the total hours recorded for the station (see

Table 10). All of these activities involved three or more people. One person on station took responsibility for making radio contact and initiating the phone patches, and then other people at the station would enter the room when their phone patches had been put through. While it was not reported on the personal projects forms, the HAMM shack was also used occasionally in the evenings by individuals wishing to monitor world news. The activities reported for the HAMM shack were made up of projects done principally for personal reasons rather than work (94%). The personal activities taking place in this room represented 2% of the personal activities taking place at the entire station. All of the hours recorded for this room were for projects that included three or more people (these projects incorporated those individuals waiting for their turn in the pub/lounge).

The parts room on the second floor contains machine parts for the power plant and heavy equipment. This room has a high ceiling and metal walls painted blue. The lighting is incandescent and the floor is metal. The wall has shelves along its walls with a desk in one corner. There are no windows. This room was used solely for work purposes although its central location often made it a place where people stopped to talk to the individuals working there. The information on the personal projects forms indicated that 132 hours were spent in this room over the winter. This number represents less than 1% of the total hours reported for the station. All of these recorded activities were for work purposes and were conducted with one other person (see Table 10).

The station store has beverages (alcoholic and non-alcoholic) and sundries for station personnel to purchase. The room is tiled in white linoleum, has incandescent lighting, and white walls. Shelves line the walls and run down the center of the room. There is a counter at one end where

purchases were made. There is a small refrigerator behind the counter. During the winter this room was only opened when people indicated that they wanted to purchase items. It was only used rarely and primarily for this function. The personal projects forms do not record this type of use. The only information reported on the use of the store was four hours of inventory. This activity was for work purposes and was carried out alone (see Table 10).

The bedrooms in this building are of various sizes. All of the bedrooms in GWR are larger than the bedrooms in the biology building. The residents of these rooms were able to be more creative in fixing up their rooms because the furniture was not built in, and the wall surfaces could be painted. These were the first rooms to be chosen by the winter over crew. They were chosen first because they had flexible furniture and because they were larger. These rooms are tiled in white linoleum, and have incandescent lighting, and acoustic tiled ceilings. Each room had at least one window about two feet wide and three feet high. Those rooms located over the power plant tend to be noisy. The bedrooms in both GWR and the biology building were treated as private areas. One did not enter another person's bedroom without permission. The records from the personal projects forms indicate that bedrooms got a lot of use. The GWR bedrooms were used for a total of 1,754 hours (see Table 10). This number does not include the use of these rooms for sleeping. Of that time, 95% of it was spent in solitary behavior (1,674 hours). Activities of a personal nature represent 70% of the hours reported. Work projects took up 9% of the activities reported, while projects involving both work and personal goals represented 20% of the hours spent in GWR bedrooms. Aggregated information about all the bedrooms at the station will be presented after the information on the biology building bedrooms.

The library is a room similar in size and construction to the bedrooms in GWR. The lighting, ceilings, walls and floors are composed of the same materials. The walls were painted white. There were two windows in this room that were the same dimensions as the windows in the bedrooms. This room was used by one of the scientists for an office and to house his computer. It was understood that other people might use the room to take advantage of the drafting table, library books, and microfiche that are located here. If someone were using this room and the door was left open, people would often stop by to chat. The hours of library use reported in the personal projects forms was 110 hours (see Table 10). This number is less than 1% of the hours reported for the entire station. The projects that took place in the library were all conducted alone. Only 35% of the activities were solely for work, while 65% involved work and personal elements.

The hallways on the second floor of GWR are tiled with white linoleum, and are illuminated by incandescent fixtures hanging from the ceilings. The walls are white but have blue and red graphic striping near the base board. These graphics were done by a previous winter over resident. There are pennants hung along the length of the hall representing ships and colleges.

There is one restroom on the floor which is for men. It contains one shower as well as two sinks, one urinal and one toilet. Stencils of krill are painted around the base of the walls. These paintings were done by a previous winter over inhabitant. The lack of a women's restroom in this building restricts the housing of women to the biology building, especially during the summer under more crowded conditions.

The deck on the roof of GWR is made of wood and is about ten feet square. There is a wood railing around the outside of it. The deck was used primarily for socializing and personal activities, although the personal

project forms had only work projects reported on them. The deck was used to learn mountain climbing techniques (it was used as a high point to descent from), star gazing, and look for ships and planes. The activities recorded on the personal projects forms indicated that 20 hours of work took place on the deck (see Table 10). These activities took place with three or more people 60% of the time (12 hours); 20% of the time with two other people; and 20% of the time with one other person.

On the first floor of the GWR building is the garage which is large enough to house some of the heavy equipment used on station. The room is lit by incandescent fixtures, has an unpainted metal floor, and painted metal walls. There are work benches along two sides of the room. There are laundry facilities at the end of the room opposite the garage door. In the corner next to the laundry is a toilet stall which is often utilized by women using the building who do not wish to go back to biology to access restroom facilities. The garage was used for work purposes and also served as a passageway to the second floor stairs. People would often stop and talk with whoever was working in the garage. A total of 604 hours were reported for the use of the garage, this represented 3% of the total hours reported for the station (see Table 10). All of the hours in the garage were for work purposes. These reported work hours are 7% of the total work hours reported for the station. Working alone in the garage accounted for 40% of the time spent there. Working with one other person represented 56% of the hours spent there.

The power plant contains the diesel generators, and desalinization equipment for the station. The room is so loud that ear protection is required. This room has painted floors and walls. The diesels are always kept painted. The lighting is incandescent. This room was used principally

for work purposes although one of the subjects indicated that he would use this room to go and think in because he knew he would not be disturbed. Information from the personal project forms indicate that the power plant was used for 64 hours on work projects, and that these activities were conducted alone (see Table 10).

The remainder of the first floor of GWR was taken up by food, parts, clothing, outdoor equipment, and stationary supply rooms. All of these rooms, except stationary supplies, resemble warehouse rooms. They were used primarily for functional purposes, although one of the crew had an office in this area. The office was away from traffic and so was rarely used to socialize. These storage areas have wood planked floors or are covered with rubber mats. The lighting is incandescent, and the walls are hard to see because they are covered by shelves or stacked boxes. The stationary supplies were kept in a space under the staricase leading to the second floor from the garage. This area was closed off by a metal caging which had a door in it. A key was necessary to access this area as it was for the clothing and outdoor equipment room.

A total of 40 hours of use of the parts storage room on the first floor of GWR was recorded on the personal project forms. All of this activity was for personal reasons and was conducted alone. This time was used to scavange materials and make Halloween costumes.

Sixteen hours of solitary work was reported for the stationery supply room. This time was used to conduct the once a year inventory of these supplies.

Six hours of solitary work on the GWR loading dock was reported on the personal projects forms. The loading dock is located next to the garage

entrance. Some of the mechanical repairs were conducted on the heavy equipment here because those vehicles were too large to fit in the garage.

The carpentry shop is a free standing, one story building located between the biology building and the GWR building. It is approachable by the wooden walkways between the buildings, or by the road from the dock to GWR. It has two doors on opposite sides of the building. One is located on the wooden walk and the other faces the road. There are windows along the two other walls in this building. The walls and floors are made of unpainted plywood. The ceiling is open beamed with fluorescent lighting. The room is filled with carpentry equipment and supplies. A total of 270 hours were spent in this building according to the information from the personal projects forms (see Table 10). This figure represents 2% of the total hours reported for the station. Of these hours, 87% were spent on personal activities. These personal activities in the carpentry shop represent 4% of all those projects that were personal in nature. Work projects represent the other 36 hours spent in the carpentry shop. All of the activities reported for this building were conducted alone.

The sauna is located on the wooden walkway between the biology building and the GWR building. It is a small building paneled inside with wood. The lighting is incandescent. A total of 36 hours of use was reported for the sauna (see Table 10). This building was used only for personal activities. Several individuals took saunas most every day either after work or after their exercise in the gym. The personal projects information indicates that people took saunas alone, although there were some unreported uses of this room when as many as four people took saunas at the same time.

Biology Building

The bedrooms on the third floor of this building are quite small, with the exception of the two front bedrooms. The majority of the rooms are about nine feet wide (including the closet) and ten feet long. The furniture in these rooms are built in. The beds are metal framed Pullman bunks that fold up to become a couch. Each room has two beds in a bunk arrangement. A desk is also attached to the wall at one end of the bed. In the front two, larger bedrooms there are free-standing desks that are small office size. Closets take up the side of the rooms opposite the beds. The closet doors were made of light wood. These rooms have a window at one end that is approximately two feet wide and three feet high. The floors are tiled in white linoleum and the walls are grey vinyl. The front two bedrooms are paneled in plywood backed wood. These two rooms are carpeted. In all of these rooms the ceilings are acoustic tiled and the lighting is incandescent. The sound proofing is poor. These rooms were used primarily for sleeping, reading, and solitary activities. Four of the six people living in this building took a second room to use for crafts and/or an office. None of the bedrooms in this building were painted as part of the personalization process (because of the vinyl wall covering and built in furniture), but were only decorated with posters and memorabilia.

The bedrooms in the biology building were used for a total of 1,037 hours (see Table 10). This figure does not include the hours spent sleeping. Of this time, 97% was spent alone while 2% was spent with one other person. The biology building bedrooms were used primarily for personal purposes (59%, 608 hours). These were also used for work (7%, 76 hours) and projects which involved both work and personal objectives (33%, 344 hours).

The second bedrooms that people took in the biology building were reported to be used for a total of 364 hours. These rooms were used mostly for work (53%, 192 hours) and projects incorporating both work and personal goals (38%, 140 hours). Activities directed towards solely personal goals were conducted 9% (32 hours) of the time in these second bedrooms. Ninety-one percent of the time spent in these rooms was alone, while 9% was spent with one other person.

The hours of use reported for the bedrooms in GWR and the biology building, and the second bedrooms used in the biology building, represent a total of 3,155 hours (see Table 10). That figure is 18.4% of the total hours reported for the station on the personal projects forms. These recorded hours do not include the time spent sleeping. The time spent on activities of a personal nature in these rooms represents 32% of all personal activities reported. The activities spent in solitary behavior represents 32% of all the solitary behavior recorded, excluding sleeping.

When the number of hours of use are aggregated for all of the bedrooms in GWR and the bedrooms in the biology building (including the second bedrooms taken in the latter building), 14% or 428 hours were spent on work projects; 59%, or 1,876 hours were spent on personal activities; and 27%, or 842 hours were spent on projects incorporating both work and personal components. Solitary behavior accounted for 95% of all the activities that took place in these bedroom areas, while 4%, or 112 hours were spent in activities involving one other person.

There is a small women's restroom on this floor with one shower, toilet and sink. Efforts to use this room during the more crowded summer was competitive. The men's restroom on this floor was much larger and contained a shower, two sinks, two toilets and one urinal. It was possible to have more

than one person use the men's restroom at a time. This was not possible in the women's bathroom. Penguins were stenciled around the base of the walls in the men's bathroom.

The dining room is located on the second floor of the biology building. The dining room is a large room which is paneled in wood-like vinyl paneling. The floors are covered with a light yellow linoleum that is laid in wide strips. The ceiling is made of acoustic tiles and the lighting is fluorescent. During the day and festive dinners, these lights were often turned off or half of them were turned off. This was done because people found the fluorescent lighting too harsh and bright. The room was functionally divided into two or three areas over the course of the winter. One side of the room has a large picture window and a metal fireplace. This area has several couches which can be moved and are comfortable. These couches were usually arranged in a fashion that allowed people to look out the window, look at the fire, and hold quiet conversations with several other people.

The dining portion of the room had been arranged into one large table made up of the smaller tables used cafeteria style during the summer. It was possible for all the members of the winter crew to sit around this large table. Extra tables and chairs from the summer were stored at the sides of the room or in other areas. Mealtimes were a social time for the whole crew, especially at lunch. Festive dinners on Saturdays, holidays, and birthdays would often result in the table being prepared with table clothes, candles, and formal place settings. It was not unusual for the dining room to be decorated for these occasions from items scavenged around station. The configuration of this large table was often changed during the winter. The station was cleaned each week by all of the personnel, with rotating chores.

Rearranging the dining room was the part of the cleaning process enjoyed most by the individuals assigned to clean that room. Rearranging the room was not required. During these rearranging activities, a second table was often set up for use by smaller numbers of personnel for games or conversation. The dining room was frequently used during non-meal hours as a place to socialize with a smaller number of people. At night it was an alternative socializing spot to the pub/lounge.

The walls of the dining room are hung with the pictures of former winter over crews and plaques from visiting ships. Several times during the year these wall hangings were rearranged also.

Information provided by the personal projects forms indicate that the dining room was used for a total of 1,131 hours, or 7% of the total hours reported (see Table 10). For the most part, these reported hours do not include time spent on meals because they were not considered projects people were undertaking. Saturday formal dinners were infrequently mentioned on the personal projects forms. The hours reported represent time spent on personal activities (57% or 642 hours), or projects involving combined work and personal pursuits (43%, 492 hours). No activities that were strictly for work purposes were reported for the dining room area although answers on several of the questionnaires indicated that the dining room was sometimes used for these purposes. According to the questionnaire, this occurred when more room was needed, and/or the work did not require a great amount of concentration. Solitary behavior in the dining room was reported for 78% of the activities recorded on the personal projects forms. Twenty-two percent of the hours reported were for activities involving three or more people. Many of the solitary activities recorded may have been those in which one person was

responsible for the activity, but did not exclude that individual from interacting socially with people who came through the dining room.

There is a deck that is in front of the dining room and the picture window. This deck had a couch and a barbecue on it. On sunny, relatively warm days it was used to relax and look at the scenery. The barbecue was used all winter in all weather conditions. Only 24 hours of use were recorded on the personal project forms for the deck. Those hours were for solitary personal activities (see Table 10).

The kitchen is fairly small with steam tables and cooking equipment occupying most of the room. The walls are painted a soft, light yellow, the floor is tiled in off-white linoleum, and the ceilings and lighting is similar to the dining room. This was often the site of social gatherings before meal times. This occurred even though the area was not designed for people to sit in. A total of 388 hours were reported for the kitchen on the personal projects forms (see Table 10). This figure represents 2% of the total hours reported on the forms for the station. Work projects accounted for 44% of these hours, and 56% of these hours were for personal objectives. All of the hours designated as spent in the kitchen were for solitary purposes.

The food storage areas were only used for functional purposes and as the cook's office. These areas are painted blue, or have metal walls. The floors are tiled linoleum or metal flooring, and the lighting is both fluorescent and incandescent. These areas are primarily filled with shelves for storage. There are two walk-in refrigerators (one of which is a freezer). There are several windows on the walls of these storage areas. There were no hours reported for these rooms on the personal projects forms.

The biological storage room was also used only for functional purposes. It is constructed in a similar fashion to the food storage areas with linoleum

tiled floors. Fluorescent lighting, and metal walls. It too is filled with shelves and has windows along one side. No hours were reported for this area on the personal project forms.

The electrical technician's shop is tiled in white linoleum, has acoustic ceiling and fluorescent lighting. The walls were covered with shelves and drawers. There is one small window. This room is only used for work purposes, principally by the communications officer, but also by other personnel who used the computer to enter inventory information. The electrical technician shop was used 387 hours during the winter according to the personal projects forms (see Table 10). This figure accounts for 2% of the hours reported for the entire station. Work projects represented 98% of the hours reported for this room. Those work hours are 4% of all the work hours recorded for the station. All of the activities in this room were conducted alone.

The manager's office is painted white and has sheet linoleum that is the same as the flooring found in the dining room. The light is fluorescent. There is one small window. The room contains a large desk, two chairs and shelves. Eighty hours of solitary work was reported for this room on the personal projects forms (see Table 10).

The facilities engineer's office is identical to the manager's office in size, lighting, flooring, wall color and ceiling material. At the far end of the room from the door is a small window. It contains equipment for recording the weather along one wall. It has a small desk on the opposite wall that holds weather reference materials. On the same side of the room as the weather equipment is a large desk. The larger desk was used by one of the scientists the first half of the winter to place a computer on. The computer was often a gathering point for one to three people who would play games on it

in their free time. This office was also used to collect the data taken weekly for this NASA study because it was quiet and in a central area. A total of 338 hours of use were reported on the personal projects forms for this room (see Table 10). Projects that were for work purposes consisted of 198 hours, or 59% of the time spent in the facilities engineer's office. Thirty-two percent of the time reported was for activities that combined work and personal objectives. Solitary behavior accounted for 12% of the time in this office, while 24% was spent with one other person. Projects that involved two other people represented 27% of the time in this room. Forty-three percent of the time spent in this room was spent with three or more people.

The communications room is tiled in white linoleum, paneled with plywood backed wood paneling, and lit by fluorescent lights. This room is filled, on all four walls, with communication equipment including radios, computers, and teletype machines. There are two windows in the room. The room was used principally by the communications officer. During those times when the communications officer was not on duty, other people used the room to type radiograms into the computer for transmitting, and used the computer for other purposes. When the radio equipment in the HAMM shack was not functioning, the radios in the communications room in the biology building were used for personal transmissions. Projects reported for this room took 844 hours, or 5% of the hours reported for the entire station (see Table 10). All of the hours recorded for this room were spent on work projects. The work hours for this area accounted for 10% of the work hours for the whole station. Solitary activities were only 6% of the hours spent in this room. Behavior involving one other person accounted for 12% of the time in the communications room. Activities that included two other people represented 68% of the hours for

this room and projects that were conducted with three or more people took up 14% of the time for this area.

The darkroom is painted black, has formica covered counters and a sink. An enlarger is positioned on a stand at the opposite wall from the door. The flooring is the same used in the dining room. This room is very small and was rarely used by more than one person at a time. The hours for this room that were reported on the personal projects forms totaled 148 hours (see Table 10). Personal activities accounted for 86% of this time. Projects that were for work purposes only accounted for 11%. The majority of the time spent in this room was in solitary behavior (96%).

The first floor of the biology building has the old boat shop which was used during the winter as a garden and a place for messy work such as spray painting, carpentry, and as a staging area for the weekly collection and sorting of garbage. The floors are covered with rubber mats, the walls are painted beige, and the lighting is incandescent. The ceiling is open to the metal floor of the second story. There is one window facing the carpentry shop. The garden was in a two-tiered arrangement. The soil was in wood flats on a wood frame that also held grow lights. The salads that were enjoyed once a week were grown here. This room was used infrequently. No personal projects were reported for it.

The laboratories NR5 and NR6 are similar in size and construction material. Both have painted walls. NR5 has green walls while NR6 has yellow walls. Both are tiled with white linoleum and fluorescent lighting. NR6 contained instruments for weighing biological samples and was used solely for this purpose. NR6 was designated as the laboratory for atmospheric research. Both rooms have small windows. NR5 had counter and desk space as well as a sink. No personal projects were recorded for either of these rooms.

The common lab contains equipment for filling scuba tanks and for washing lab glassware. The walls are painted blue, the floor is white linoleum tiles, and the lighting is fluorescent. There is a window over the sink that faces the inlet in front of the building. This room was used primarily for functional activities. However, because of its central location and the way that the door faces onto the hall, people would often stop to talk to whoever was using the room. Because of the short time quality of the chores that were done in this room, no personal projects were recorded for it.

The machine shop/equipment room is quite large. The floors are painted metal floors, the walls are metal, and the lighting is fluorescent. One fourth of the room is filled with machining equipment. The remainder of the room is filled with heating, power, fresh water storage, fire prevention system and other utility machinery. This room was used principally as a passageway to the back door of the biology building, and for functional purposes. When the machining tools were used people would often stop and talk to the operator because of the proximity of the equipment to the door to the hallway. A total of 12 hours were reported for the machine shop (see Table 10). All of this activity was for work purposes and was of a solitary nature.

The dive locker lab was used by two scientists principally for work related tasks. One of the scientists also used it as a place to write letters and listen to music. Because it is located in a high traffic area, people often stopped to chat. The room has blue painted walls with one small window. There are double doors opening to the outside on the front of the building, and a single door leading to the hallway. The floor is made out of a special water proof material. The lighting is fluorescent and the ceiling is open to the metal of the floor above. The room is plumbed for water and

has counters around the room with several cut outs for desk surfaces. There are also a counter and a table that run down the middle of the room. The personal projects forms indicate that a total of 1292 hours were spent in this room. This represents 8% of all the hours reported for the station (see Table 10). Ninety percent of the hours in this lab were for work purposes. Activities that had elements of both work and personal goals accounted for 9% of the hours in the dive lab. The work hours reported for this room represented 13% of all the work hours reported for the station. Solitary behavior accounted for 23% of the time in the room. Activities with one other person consumed 3% of the hours. Projects that included two other individuals took up 56% of the time, while those activities that incorporated three or more accounted for 17% of the time in this lab.

The dispensary is tiled in white linoleum and has green walls. The lighting is fluorescent. This room is very similar to any medical examination room in how it is set up. It has a small office separated by walls and a door from the examining room. The office has a small desk and shelves with a small window facing the aquarium building. The dispensary was used only by the medic and was not a place where socializing took place. A total of 20 hours were reported for the dispensary on the personal projects forms (see Table 10). These hours were for work purposes and were carried out alone most of the time (80% alone). Activities that involved three or more people took place in the dispensary 20% of the time.

Laboratory NR4 was used the last third of the winter as a computer room and office by one of the scientists. The computer was moved to this room from the facilities engineer's office because of water and snow leaking into the office. The NR4 lab is blue in color, with a green ceramic tile floor. The lighting is fluorescent. The room contains a desk counter and drawers along

one wall, with tables and freezers located on the opposite wall. There is a small window facing the aquarium building. This room was used primarily for work purposes, however the computer was used in the evening infrequently for recreational purposes. Forty hours were reported on the personal projects forms for this lab (see Table 10). Of those hours reported, 80% were for work purposes, and 20% were for activities having both work and personal qualities. Activities with three or more people account for 70% of the hours for this room. Projects with one other person took 20% of the time spent in the lab, while 10% of those hours were for activities that included two other people.

Laboratories NR2 and NR3 are very similar in construction. NR3 has a sink while NR2 does not. These labs are open lab bays with no doors separating them from the hallway. The floors are green ceramic tile, the walls are painted white, the lighting is fluorescent, and the ceilings are open to the metal floors above. The heating on this floor, in this wing of the building is poor. On windy days it was very difficult to use the rooms in this wing because of the cold. NR2-3 are lined with laboratory counters that have drawers and cut outs for desk areas. There are shelves above the counters. There is a small window in the narrow end of each of these labs that face the aquarium. Each of the lab spaces were used by only one person, but people often stopped to talk to the individuals assigned to these lab spaces. Of the hours reported on the personal projects forms, NR2 was used for a total of 772 hours or 4.5% of the total hours reported for the station. All of the hours for NR2 were for work purposes and was carried out alone. These work hours represent 8.7% of all the work hours reported for the station. No hours were reported for NR3 on the personal projects forms.

NR1 is a larger laboratory than NR2. It has sea water tables on one side of it. The walls are painted white, and the flooring is made of special water proof brick red material. The lighting is fluorescent. This room has two lab bays which are formed by counters with drawers and desk cut outs. There are shelves on the wall over the portion of these lab bays that abut the wall. There are double doors leading out the front of the building and a small window on the back of the building facing the aquarium. This room was always cold because of the sea water tables and the double doors. It was a place where several of the scientists would often chat during the day because of its location near the doors closest to the aquarium. The hours reported for this room on the personal projects forms totaled 740 hours, which represents 4.3% of the hours recorded for the entire station (see Table 10). Of the hours reported for the NR1 lab, 78% were for work. Activities incorporating both work and personal objectives represented 22% of the time in the lab. The work hours for this room accounted for 6.5% of the work hours reported for the entire station. All of the activities reported were of a solitary nature.

The cold room lab is a separate one story building located in front of the NR1 lab. It has painted off-white walls, linoleum tiled floors, and fluorescent lighting. It has counters along the outside walls of the building and is kept at a low temperature to maintain marine organisms. This room was only used for work purposes. No hours were recorded on the personal projects forms for this room.

The aquarium building was located on the opposite side of the NR1 lab from the cold room lab. It is a free standing, one story building with a large deck. There is a garage door that opens onto the deck. This door is used to move the large tanks in and out of the building. There are two regular doors. One opens out onto the deck. The other is located near the

rear door of the biology building. This room was unfinished at the time of the study. The walls had been sheet rocked but not painted. The floor was still unfinished plywood. The lighting is fluorescent and there are radiant heaters suspended from the ceiling. There are windows facing the bay and the glacier face. At the time of the study there were seven circular tanks in the middle of the room that only allowed enough room for people to walk along the outside of the tanks. There are two smaller rooms with tanks at the opposite end of the aquarium from the garage door. These were closed off by black plastic during the winter for purposes of marine studies being conducted. This room was typically the same temperature as the ambient outside temperature. There were laboratory counters with drawers and desk cut outs along the side of the building facing the biology building. There was also a lab desk in front of the window facing the bay. This room was primarily used for work purposes. Sometimes the very fact that several people would be working there at the same time facilitated casual conversation. The animals in the tanks were a source of interest to all members of the station and this resulted in people periodically coming by to see what was going on in this building. A total of 1158 hours were reported on the personal projects forms for the aquarium (see Table 10). The hours of use reported for this building represent 7% of the hours reported for the entire station. The projects in this room were for work purposes only. The work hours reported for this building account for 13% of the total work hours reported for the station. Time spent with two other people accounts for 86% of the hours spent in the aquarium, while 10% was spent with three or more people.

The new boat shop is located on the side of the biology building that the dive locker and common lab were situated. It is a free standing, one story building with a wood ramp used to haul the boats to and from the boat shop.

There is a garage door located on the same side of the building as the ramp. The interior of this room was also unfinished at the time of the study. The walls had been sheet rocked but not painted. The floor was covered at that time with rubber mats. The lighting was fluorescent. There were shelves and counters against all of the walls. There are doors located facing the biology building and the boat ramp. There are windows facing the biology building and the boat ramp. There are windows facing the biology building and the inlet. This room was used primarily to store boats: fix mechanical equipment; and to monitor scientific experiments taking place in the inlet. No hours of use were indicated on the personal projects forms for this building.

Night watch was a responsibility that was rotated among all of the members of the winter crew. For a period of one week, the person on night watch would go through all of the buildings on station and to outlying pipes and lines, every two hours. These rounds were to check for fire and equipment malfunctions. During the day several of the support staff would also make periodic checks around the station. In addition, end of the year cleaning activities required similar movement around the station. A total of 2086 hours were reported on the personal projects forms for these types of activities. This figure represented 13% of all the activities reported for the station (see Table 10). Work projects accounted for 91% of the hours that were involved in moving through all of the station in this fashion. Personal activities that required moving around the whole station represented 9% of this time. Sixty-two percent of the time individuals conducted these activities by themselves. Thirty-six percent of the time these types of activities were spent with three or more people.

Activities that took place outside, and that were reported on the personal projects forms took 662 hours or 4% of the total hours reported for

the station (see Table 10). Thirty-three percent of the time spent outside was solely for work purposes. Personal activities accounted for 34% of the outdoor hours, while 33% was for projects that incorporated both elements of work and personal objectives. Solitary outdoor behavior accounted for 41% of the hours. Activities that involved one other person accounted for 12% of the time. Projects that included two other people took up 26% of the time outside, while projects involving three or more people took up 21% of the outdoor hours.

The information about the use of the physical facilities highlight several issues in the design of dwellings for ICE's. The data suggests the importance of creating distinct areas for work and recreational activities. The high proportion of activities carried out alone, and the extensive use of the bedrooms for solitary purposes indicate the need for spaces which provide privacy. At the other end of the spectrum, rooms that were identified as places to socialize because of their location and functional definition, were heavily used by station residents. Finally, the role of flexible environments is significant in an ICE because it allows for novelty and personalization in an other wise sterile and low stimulus setting. These issues will be discussed in more detail below.

Projects of a work nature were conducted in those areas of the station set aside for work for each of the subjects in the study. Questionnaires filled out at the end of the winter on the use of the physical facilities indicated that sometimes paper work was taken to a public area such as the dining room or the pub/lounge when more room was needed to spread out, or when the work did not require a great amount of concentration (see Appendix A for the tabulation of the questionnaires). Bedrooms or additional private rooms that people set aside for themselves, were also used to do paper work when the

individual desired more privacy than their work space provided. While work areas were not considered private areas it seemed to be important for individuals to have defined areas to work that they could call their own and not have to compete with others for their use.

Recreation areas took several forms. The clearest way of distinguishing between them was the level of social interaction that took place. The pub/lounge and dining rooms were the areas most often used for personal activities (non-work) that involved three or more people. The questionnaires indicate that these two areas were the most likely to be chosen by people to socialize. These rooms were chosen for this purpose because they were areas with high people traffic; they were designated as socializing areas by the nature of their functional design and group norms; because they had music and other equipment needed for socializing; because there was food present; and because they were comfortable and spacious. Two problems with these rooms were their proximity to sleeping areas, and, in the case of the pub/lounge, conflicts over the recreational use of the area. In both rooms noise would carry to the sleeping areas, and loud music resulted in complaints. In the pub/lounge the juxtaposition of the bar area which had a stereo, next to the video viewing area of the lounge, led to the establishment of rules about how the room would be used at different hours of the evening when activities might clash. All agreed it would have been more useful to have the video room separate from the bar. In this scenario the game tables would have been located in the same area as the bar.

What emerges from the data on areas in which large group socializing takes place is the need to: locate these rooms near high traffic areas; separate them visually and in an auditory fashion from private quarters that might be used for sleeping; to equip the recreational rooms with items that

facilitate socializing (music, food, game tables, videos, comfortable furniture, etc.) but to separate socializing areas that might have conflicting use.

A wider range of settings were used for social interactions that took place in groups of two to three. These areas included the labs on the first floor of the biology building; the fireplace area in the dining room; the gym during exercise; the rooms containing the computers; the dining room during non-meal hours for games or casual conversation; and the out-of-doors. Conversations in the lab, dining room, or around the fireplace were usually impromptu, taking place when two or three people met in passing. Other settings, such as the gym or the out-of-doors were places where people consciously set up activities to do with each other. In designing an ICE it could be important to create spaces which are distinct from the private rooms and the large group socializing areas, which could be used for casual conversation. This could be the dining room, or work areas after work is completed.

It is also important to have recreational areas where people are able to get physical exercise. As noted, the gym was used from the early morning until the evening. In addition, the winter crew was able to get outside frequently to ski, hike, and pursue other forms of exercise. Many of the hobbies had a physical component to them, whether it was working in the carpentry shop with tools, rock climbing, or juggling. All of this underlines the importance of having facilities where ICE inhabitants can get exercise. It was interesting to note that Space Lab crew members would also orient their exercycle so that they could look out the window into space. The fact that this type of behavior occurs in both Antarctic and space ICE' suggests the importance of including openings to the outdoors in the exercise rooms, and/or

providing video and music equipment to entertain crew members while they exercise.

During the winter in Antarctica people reported that they spent 60% of their time alone and this figure did not include hours of sleep. Much of this time was for work purposes but a great portion of it was spent in individuals' bedrooms. Time spent alone in bedrooms accounted for over 18% of the time reported for the station. This indicates the important function of private, isolated spaces in ICE's. Ideally such spaces should provide visual and acoustic privacy, work areas for projects, and where possible, storage space for hobby/personal activities. On the questionnaires, people indicated that they used their bedrooms as a place to be alone because it was a place where others would not disturb them. Bedrooms very rarely served as a place to socialize. People never entered another person's room without permission. It was an unspoken rule that bedrooms were places that were inviolable.

Privacy played an important role in this Antarctic ICE. There were two types of privacy issues, visual and auditory privacy. During the winter months visual privacy was not a problem. The station was large enough so that people were able to have their own rooms and get away from each other. During the summer, people shared rooms and visual privacy was an issue. In ICE's which are crowded and require crew members to share sleeping rooms it is important to provide some form of visual privacy. On ships this is done by putting curtains around individual bunks. Auditory privacy was more of a problem. There were few rooms in the station that were sound proof. It was difficult to hold a conversation in a room without the people next door hearing what was discussed. This issue is important in separating social and work areas from berthing areas as well as insulating one bedroom from the next. In this Antarctic setting, confidential, private conversations were

held outside, in buildings not connected to the main buildings (the carpentry shop, sauna, new boat shop), or in rooms where there was enough background noise, due to equipment, that the conversation would not carry.

It is important to have flexible environments in ICE's because they provide novelty and an opportunity to personalize the setting. Flexibility can take place at a furnishing level. During the winter rooms such as the pub/lounge and dining room were continuously being rearranged. The bedrooms in GWR were chosen first, not only because they were larger but also because they had furniture that was movable. Walls that offer the quality of being changeable were also valued. The walls in the bedrooms in GWR could be painted while those in the biology building could not. Personalization of rooms in GWR often was done by painting the rooms. The hall walls in GWR were painted and had had graphics painted on them. This was not an option in the third floor hallway of the biology building. Wall hangings in the dining room and pub/lounge allowed people to rearrange them or add to them to make them more personal.

Flexible environments also allow the introduction of new stimuli to the environment. In a low stimulus setting such as an ICE, changing the furniture, painting the walls, or hanging a new poster can add novelty. Novelty seems to be important in ICE settings. When people were asked what they would bring if they were going to winter over again, a number of people indicated that they would bring down items that they could share with other members during the middle of the winter when novel items were not expected and the environment had been thoroughly mapped out. Novelty may also be the driving force behind the parties that took place on station. People prepared elaborate parties for birthdays and holidays. Extensive amounts of time were spent on decorations, costumes, and presents. Settings which are flexible may

help residents in their efforts to create new and interesting environmental stimuli.

It is clear that the built environment has an impact on the inhabitants of ICE's. The manner in which people use and modify their dwelling give us information about what works well and what needs to be changed to enhance the quality of life. It is important to remember that while most ICE's are put in place to achieve some goal of a scientific, business, or defense nature, that the people who choose or are required to inhabit those settings must not only live there but must make it a home. Habitats which are designed to serve not only the work objectives but also the residential ones will help improve the health and productive qualities of the ICE settings.

Conclusion

This research has set out to achieve three major goals. The first objective was to look at how people adapt over time to the chronic and acute stressors of an ICE. The second purpose of the study was to examine what kinds of behavior occurs in an ICE and how that behavior influences physiological and psychological outcomes. The final objective was to assess how people use and modify their built environment in order that guidelines could be developed for the design of future ICE's. The data set used in this study is rich and complex. This report contains findings from the "first run" at the data. Future analyses will attempt to answer many of the questions raised in this report. Those findings that emerged have offered guidelines about patterns of adaptation that could be expected in an ICE. It also has discussed how these settings can be programmed to facilitate successful adjustment. Finally, it provides information about how to design future ICE habitats to maximize a health living environment.

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DATA COLLECTION SUMMARY

TABLE 1

Instrument	Schedule of Administration
Bipolar Profile of Mood States	Three times a week, one each: morning, afternoon, evening.
Blood Pressure	Two times a week in the late afternoon. On two of the same days POMS is filled out.
Urinary Catecholamines	Once a week for the first eight waking hours. On one of the days blood pressure taken.
Personal Projects	Once a month
Questionnaire including: Demographics (1st month only) Personal inventory of items Miscellaneous questions about physical environment.	First, fourth and seventh month.
Journal	Daily
Weather Records	Daily

TABLE 2

Monthly Group Means for Physiological and Psychological Outcome Measures

Month	Systolic Blood Pressure (mm Hg)	Diastolic Blood Pressure (mm Hg)	Epinephrine (ng/hr)	Norepinephrine (ng/hr)
May	121.05	76.57	1001.67	4112.68
June	121.64	77.00	1096.72	4270.66
July	121.33	78.80	792.83	3719.98
August	122.25	77.39	774.72	3190.85
September	118.85	77.82	779.67	2985.29
October	121.24	78.56	901.55	3456.11
November	124.67	81.54	1046.27	4221.76
Mean for Entire ICE	121.28	78.03	897.49	3657.33

POMS Bipolar Mood Scales

	Anxiety-Composed*	Hostile-Agreeable*	Depressed-Elated*
May	25.26	28.62	24.28
June	23.90	27.63	22.67
July	24.26	27.77	22.39
August	23.10	27.36	22.78
September	22.73	26.82	22.42
October	21.40	26.15	20.72
November	21.05	25.43	20.09
Mean for Entire ICE	23.30	27.26	22.38

*On the POMS scales the higher the score the more positive the mood, the lower the score the more negative the mood. As the scores decline on the depression-elated scale, for example, the more depressed the individual is.

TABLE 3

Correlation Matrix for the Physiological and Psychological Measures

	SBP	DBP	EPIN	NEPIN	ANX	DEPR	HOST
SBP							
(Coefficient)		.624	.104	.036	.103	.132	.003
# cases		503	220	220	485	485	485
P =		.000	.123	.597	.024	.004	.951
DBP							
(Coefficient)			.001	-.028	-.050	.059	-.158
# cases			220	220	485	485	485
P =			.123	.597	.024	.004	.951
EPIN							
(Coefficient)				.887	-.029	.010	.037
# cases				220	214	214	214
P =				.000	.676	.882	.591
NEPIN							
(Coefficient)					.073	.097	.119
# cases					214	214	214
P =					.286	.159	.083
ANX							
(Coefficient)						.748	.739
# cases						719	719
P =						.000	.000
DEPR							
(Coefficient)							.768
# cases							719
P =							.000

SBP = Systolic Blood Pressure
DBP = Diastolic Blood Pressure
EPIN = Epinephrine
NEPIN = Norepinephrine
ANX = Anxiety-Composed Bipolar POMS scale (higher scores = more composed; lower scores = more anxious)
DEPR = Depression-Elated Bipolar POMS scale (higher scores = more elated; lower scores = more depressed)
HOST = Hostility-Agreeable Bipolar POMS scale (higher scores = more agreeable; lower scores = more hostile)

TABLE 4

Group Means for Physiological and Psychological Measures
During Significant Environmental Events

Event	Systolic Blood Pressure (mm Hg)	Diastolic Blood Pressure (mm Hg)	Epinephrine (ng/hr)	Norepinephrine (ng/hr)
Festivities	121.6	77.8	1054	4421
Strong Winds Longer Than A Week	120.2	78.4	766	3261
Winter Ship Visits	119	77.6	792	3057
Summer Crew Arrives	126.5	84.5	997	4689
Means for Entire ICE	121.3	78	897	3657

POMS Bipolar Mood Scales

	Anxiety-Composed*	Hostile-Agreeable*	Depressed-Elated*
Festivities	23.75	27.63	22.88
Strong Winds Longer Than A Week	23.1	26.8	21.7
Winter Ship Visits	22.3	26.9	22.46
Summer Crew Arrives	20	25.5	21.75
Means for Entire ICE	23.3	27.3	22.4

*On the POMS scales the higher the score the more positive the mood, the lower the score the more negative the mood. As the scores decline on the depression-elated scale, for example, the more depressed the individual is.

TABLE 5

Work and Personal Activities for the Winter ICE

	Work Activities		Personal Activities		Combined Activities		TOTAL
MONTH	HOURS	%	HOURS	%	HOURS	%	HOURS
May	1556	57%	936	34%	248	9%	2740
June	1164	43%	1048	40%	480	18%	2692
July	1575	58%	972	36%	180	6%	2727
August	1004	45%	732	32%	552	24%	2288
September	1428	51%	836	30%	540	19%	2804
October	1512	58%	836	32%	256	10%	2604
November (2 Weeks)	610	48%	492	39%	171	13%	1273
TOTAL HOURS AND MEAN PERCENT	8846	52%	5812	34%	2366	14%	17136

TABLE 6

Orientation of Activities Over the Winter ICE

	Antarctic Activities		Home Oriented Activities		Activities Oriented To Antarctica and Home	
MONTH	HOURS	%	HOURS	%	HOURS	%
May	1952	71%	412	15%	376	14%
June	1636	61%	532	20%	524	19%
July	1428	54%	580	22%	660	25%
August	1456	65%	372	16%	420	19%
September	2120	76%	152	5%	532	19%
October	1896	73%	324	12%	380	15%
November (2 Weeks)	892	70%	280	22%	100	8%
TOTAL HOURS AND MEAN PERCENT	11380	66%	2652	15%	2992	17%

TABLE 7

Social Level of Contact Over the Winter ICE

	Activities Alone		Activities With One Another		Activities With Two Others		Activities With Three Others	
MONTH	HOURS	%	HOURS	%	HOURS	%	HOURS	%
May	1624	58%	72	2%	448	16%	672	24%
June	1780	66%	80	3%	448	17%	384	14%
July	1560	58%	212	8%	588	22%	308	12%
August	1476	65%	148	6%	344	15%	320	14%
September	1868	68%	128	5%	324	12%	424	15%
October	1408	54%	360	14%	480	18%	348	13%
November (2 weeks)	778	53%	156	11%	196	13%	342	23%
TOTAL HOURS AND MEAN PERCENT	10294	60%	1156	7%	2832	17%	2738	16%

TABLE 8

Correlation Between Outcome Measures and Personal Projects Data

	Orientation of Activities		Type of Activity
	Percentage Home	Percentage Antarctica	Percentage Work
SYSTOLIC BP			
Coefficient	-.241	.228	-.151
cases	37	36	40
p =	.15	.18	.35
DIASTOLIC BP			
Coefficient	-.327	.302	.250
cases	37	36	40
p =	.05	.07	.12
EPINEPHRINE			
Coefficient	-.237	.237	.188
cases	13	13	15
p =	.44	.44	.50
NOREPINEPHRINE			
Coefficient	-.09	.09	.30
cases	13	13	15
p =	.77	.77	.28
ANXIETY			
Coefficient	.228	-.241	-.346
cases	49	48	54
p =	.11	.10	.01
DEPRESSION			
Coefficient	.111	-.117	-.215
cases	49	48	54
p =	.45	.43	.12
HOSTILITY			
Coefficient	.137	-.145	-.226
cases	49	48	54
p =	.35	.37	.10

Higher scores on the anxiety-composed scale = more composed; lower scores = more anxious.
Higher scores on the depression-elated scale = more elated; lower scores = more depressed.
Higher scores on the hostility-agreeable scale = more agreeable; lower scores = more hostile.

Table 9

The Relationship between the Orientation of Activities and Their Work/Personal Categorization

Activities Oriented Towards Antarctica

	Hours	Percentage
Work	7,452	65%
Personal	3,132	28%
Both Work and Personal	796	7%
Total	11,380	

Activities Oriented Towards Home

	Hours	Percentage
Work	438	17%
Personal	1,586	60%
Both Work and Personal	628	23%
Total	2,652	

Activities Oriented Towards Both Antarctica and Home

	Hours	Percentage
Work	956	32%
Personal	1,094	37%
Both Work and Personal	942	31%
Total	2,992	

Table 10

Use of the Physical Facilities
Personal Projects

Total number of hours reported = 17,136 (not including sleep)

Bedrooms

GWR Building Bedrooms (Total hours = 1,754 hours)

Activity Classification	Hours	Percent
Work	160	9%
Personal	1,236	70%
Combination Work and Personnel	358	20%

Social Contact Level	Hours	Percent
Alone	1,674	95%
With one other person	64	4%
With two other people	16	1%
With three or more people	0	0

Biology Building Primary Bedroom (Total hours = 1,037 hours)

Activity Classification	Hours	Percent
Work	76	7%
Personal	608	59%
Combination Work and Personal	344	33%

Social Contact Level	Hours	Percent
Alone	1,004	97%
With one other person	16	2%
With two other people	4	.05%
With three or more people	4	.05%

Biology Building Secondary Bedroom (Total hours = 364 hours)

Activity Classification	Hours	Percent
Work	192	53%
Personal	32	9%
Combination Work and Personal	140	38%

Aggregated Bedrooms (Total hours = 3,155 hours; 18.4% of total hours for the station).

Activity Classification	Hours	Percent
Work	428	14%
Personal	1,876	59%
Combination Work and Personal	842	27%

Social Contact Level	Hours	Percent
Alone	3,010	95%
With one other person	112	4%
With two other people	20	.06%
With three or more people	4	.04%

Hours in All Bedrooms and Total Hours Reported for Station

Work activities: 5% of all work hours
Personal activities: 32% of all personal hours
Combination (work and personal): 36% of all combination hours
Soliary activities: 29% of all solitary hours
Activities with one other person: 10% of all hours with one other person
Activities with two other people: less than 1% of all hours with two other people
Activities with three or more people: less than 1% of all hours with three other people

Table 10

Use of the Physical Facilities
Personal Projects

Pub/Lounge (Total hours = 1,536 hours; 9% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	0	0	0
Personal	1,374	89%	23%
Combination Work and Personnel	160	10%	7%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	548	36%	5%
With one other person	28	2%	2%
With two other people	56	4%	2%
With three or more people	842	55%	30%

Gym (Total hours = 716 hours; 4% of total hours for station).

Activity Classification	Hours	Percent	Percent of the total hours for the station in this category
Work	20	3%	.2%
Personal	520	73%	9%
Combination Work and Personal	176	25%	7%

Social Contact Level	Hours	Percent	Percent of the total hours for the station in this category
Alone	592	83%	6%
With one other person	120	17%	10%
With two other people	0	0%	0%
With three or more people	4	.5%	< 1%

Table 10

Use of Physical Facilities
Personal Projects

Hamm Shack (Total hours = 134 hours; .8% of total hours for the station).

Activity Classification	Hours	Percent	Percent of the total hours for the station in this category
Work	8	6%	< 1%
Personal	126	94%	2%
Combination Work and Personal	0	0%	0%

Social Contact Level	Hours	Percent	Percent of the total hours for the station in this station
Alone	0	0%	0%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	134	100%	5%

GWR, second floor parts room (Total hours = 132 hours; .7% of total hours for the station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	132	100%	1%
Personal	0	0%	0%
Combination Work and Personal	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	0	0%	0%
With one other person	132	100%	11%
With two other people	0	0%	0%
With three or more people	0	0%	0%

Table 10

Use of the Physical Facilities
Personal Projects

Station Store (Total hours = 4 hours; less than 1% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	4	100%	< 1%
Personal	0	0%	0%
Combination Work and Personnel	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	4	100%	< 1%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

Library (total hours = 110 hours; .6% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	38	35%	.4%
Personal	0	0%	0%
Combination Work and Personal	72	65%	3%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	110	100%	1%
With one other person	0	0%	0%
With two other people	0	0%	0%
WIth three or more people	0	0%	0%

Table 10

Use of the Physical Facilities
Personal Projects

GWR, Roof Deck (Total hours = 20; .1% of total hours for station).

Activities Classification	Hours	Percent	Percent of total hours for the station in this category
Work	20	100%	.2%
Personal	0	0%	0%
Combination Work and Personal	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	0	0	0
With one other person	4	20%	< 1%
With two other people	4	20%	< 1%
With three or more people	12	60%	< 1%

Garage (Total hours = 604; 3% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	604	100%	7%
Personal	0	0%	0%
Combination Work and Personal	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	244	40%	2%
With one other person	340	56%	29%
With two other people	14	2%	< 1%
With three or more people	6	1%	< 1%

Table 10

Use of the Physical Facilities
Personal Projects

Power Plant (Total hours = 64; .3% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	64	100%	< 1%
Personal	0	0%	0%
Combination Work and Personnel	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	64	100%	< 1%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

GWR, First Floor Parts Room (Total hours = 40; .2% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	0	0%	0%
Personal	40	100%	< 1%
Combination Work and Personal	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	40	100%	< 1%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

Table 10

Use of the Physical Facilities
Personal Projects

Stationary Storage (Total hours = 16; .09% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	16	100%	< 1%
Personal	0	0%	0%
Combination Work and Personal	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	16	100%	< 1%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

GWR, Loading Dock (Total hours = 6; .03% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	6	100%	< 1%
Personal	0	0%	0%
Combination Work and Personal	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	6	100%	< 1%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

Table 10

Use of the Physical Facilities
Personal Projects

Carpentry Shop (Total hours = 270 hours; 2% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	36	13%	< 1%
Personal	234	87%	4%
Combination Work and Personnel	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	270	100%	3%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

Sauna (Total hours = 36 hours; .2% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	0	0%	0%
Personal	36	100%	< 1%
Combination Work and Personal	0	0%	0%

Social Contact Level	Hours	Percent	Percent of the total hours for the station in this category
Alone	36	100%	< 1%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

Table 10

Use of the Physical Facilities
Personal Projects

Dining Room (not for meals) (Total hours = 1,131; 7% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	0	0%	0%
Personal	640	57%	11%
Combination Work and Personnel	492	43%	21%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	884	78%	9%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	248	22%	9%

Deck off of Dining Room (Total hours = 24; .1% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	0	0%	0%
Personal	24	100%	< 1%
Combination Work and Personal	0	0%	0%

Social Contact Level	Hours	Percent	Percent of the total hours for the station in this category
Alone	24	100%	< 1%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

Table 10

Use of the Physical Facilities
Personal Projects

Kitchen (Total hours = 388; % of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	172	44%	2%
Personal	216	56%	4%
Combination Work and Personnel	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	388	100%	4%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

Electrical Technician's Shop (Total hours = 387; 2% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	379	98%	4%
Personal	0	0%	0%
Combination Work and Personal	8	2%	3%

Social Contact Level	Hours	Percent	Percent of the total hours for the station in this category
Alone	387	100%	4%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

Table 10

Use of the Physical Facilities
Personal Projects

Manager's Office (Total hours = 80; .5% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	80	100%	< 1%
Personal	0	0%	0%
Combination Work and Personnel	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	80	100%	< 1%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

Facilities Engineer's Office (Total hours = 388; 2% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	198	59%	2%
Personal	32	9%	< 1%
Combination Work and Personal	108	32%	5%

Social Contact Level	Hours	Percent	Percent of the total hours for the station in this category
Alone	40	12%	< 1%
With one other person	80	24%	7%
With two other people	74	22%	3%
With three or more people	144	43%	5%

Table 10

Use of the Physical Facilities
Personal Projects

Communications Room (Total hours = 844 hours; 5% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	844	100%	10%
Personal	0	0%	0%
Combination Work and Personnel	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	52	6%	< 1%
With one other person	100	12%	9%
With two other people	572	68%	20%
With three or more people	120	14%	4%

Darkroom (Total hours = 148; .8% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	16	11%	< 1%
Personal	128	86%	2%
Combination Work and Personal	4	3%	< 1%

Social Contact Level	Hours	Percent	Percent of the total hours for the station in this category
Alone	142	96%	1%
With one other person	0	0%	0%
With two other people	6	4%	< 1%
With three or more people	0	0%	0%

Table 10

Use of the Physical Facilities
Personal Projects

Machine Shop (Total hours = 12; .07% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	12	100%	< 1%
Personal	0	0%	0%
Combination Work and Personnel	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	12	100%	< 1%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

Dive Locker Lab (Total hours = 1,292; 8% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	1,164	90%	13%
Personal	8	.6%	< 1%
Combination Work and Personal	120	9%	5%

Social Contact Level	Hours	Percent	Percent of the total hours for the station in this category
Alone	300	23%	3%
With one other person	40	3%	3%
With two other people	728	56%	26%
With three or more people	224	17%	8%

Table 10

Use of the Physical Facilities
Personal Projects

Dispensary (Total hours = 20 hours; .1% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	20	100%	< 1%
Personal	0	0%	0%
Combination Work and Personnel	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	16	80%	< 1%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	4	20%	< 1%

NR4 Lab (Total hours = 40 hours; .2% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	32	80%	< 1%
Personal	0	0%	0%
Combination Work and Personal	8	20%	< 1%

Social Contact Level	Hours	Percent	Percent of the total hours for the station in this category
Alone	0	0%	0%
With one other person	8	20%	1%
With two other people	4	10%	< 1%
With three or more people	28	70%	1%

Table 10

Use of the Physical Facilities
Personal Projects

NR2 Lab (Total hours = 772; 5% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	772	100%	9%
Personal	0	0%	0%
Combination Work and Personnel	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	772	100%	7%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

NR1 Lab (Total hours = 740; 4% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	580	78%	7%
Personal	0	0%	0%
Combination Work and Personal	160	22%	7%

Social Contact Level	Hours	Percent	Percent of the total hours for the station in this category
Alone	740	100%	7%
With one other person	0	0%	0%
With two other people	0	0%	0%
With three or more people	0	0%	0%

Table 10

Use of the Physical Facilities
Personal Projects

Aquarium (Total hours = 1,158; 7% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	1,158	100%	13%
Personal	0	0%	0%
Combination Work and Personnel	0	0%	0%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	0	0%	0%
With one other person	40	3%	3%
With two other people	998	86%	35%
With three or more people	120	10%	4%

Night Watch and Working Around Station (Total hours = 2,086; 13% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	1,898	91%	21%
Personal	188	9%	3%
Combination Work and Personal	0	0%	0%

Social Contact Level	Hours	Percent	Percent of the total hours for the station in this category
Alone	1,292	62%	13%
With one other person	6	< 1%	< 1%
With two other people	20	2%	1%
With three or more people	760	36%	28%

Table 10

Use of the Physical Facilities
Personal Projects

Out-of-Doors (Total hours = 662; 4% of total hours for station).

Activity Classification	Hours	Percent	Percent of total hours for the station in this category
Work	220	33%	2%
Personal	226	34%	4%
Combination Work and Personnel	216	33%	9%

Social Contact Level	Hours	Percent	Percent of total hours for the station in this category
Alone	272	41%	3%
With one other person	80	12%	7%
With two other people	174	26%	6%
With three or more people	136	21%	5%

FIGURE 1A: DIASTOLIC BLOOD PRESSURE

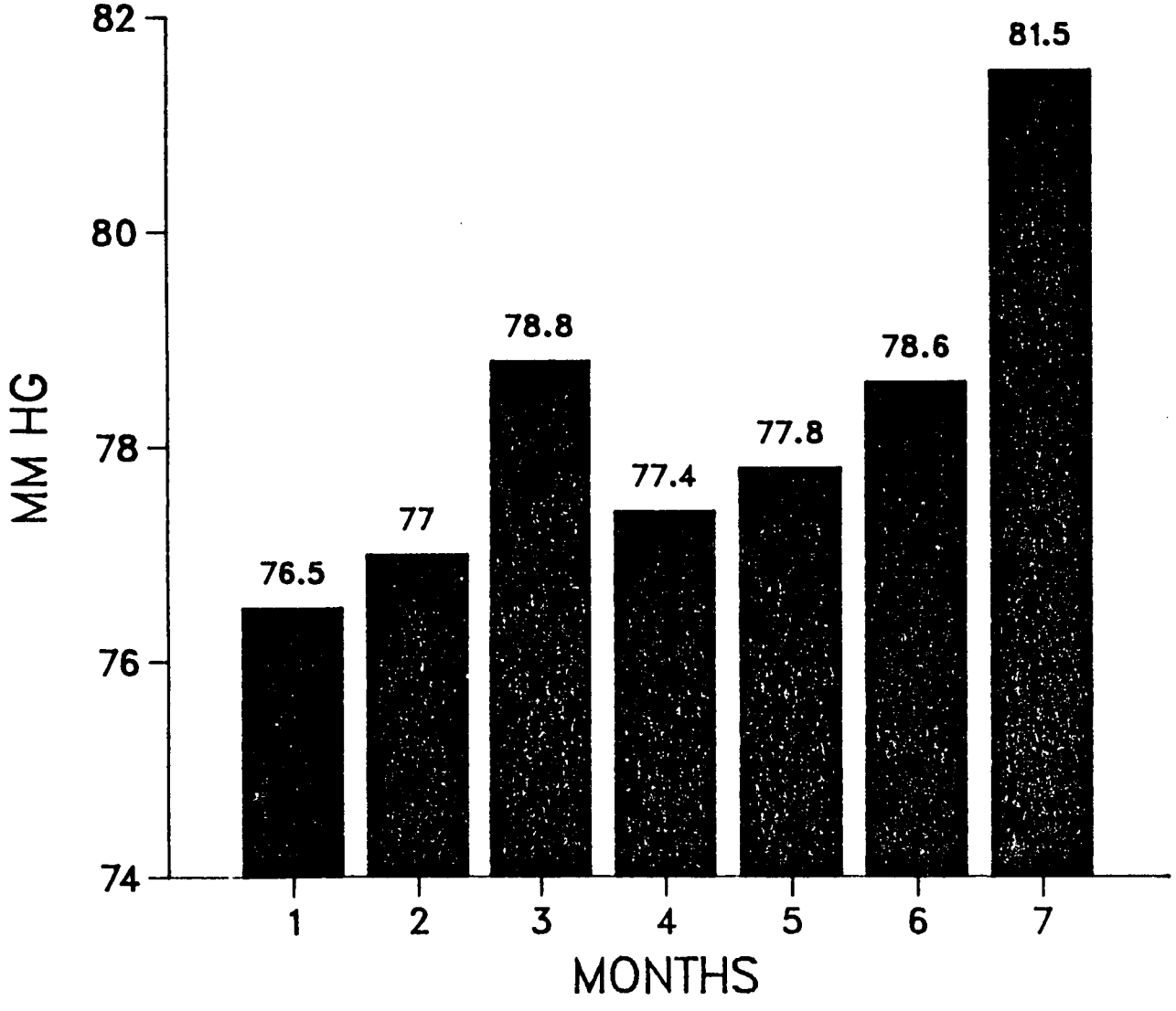


FIGURE 1B: SYSTOLIC BLOOD PRESSURE OVER THE WINTER

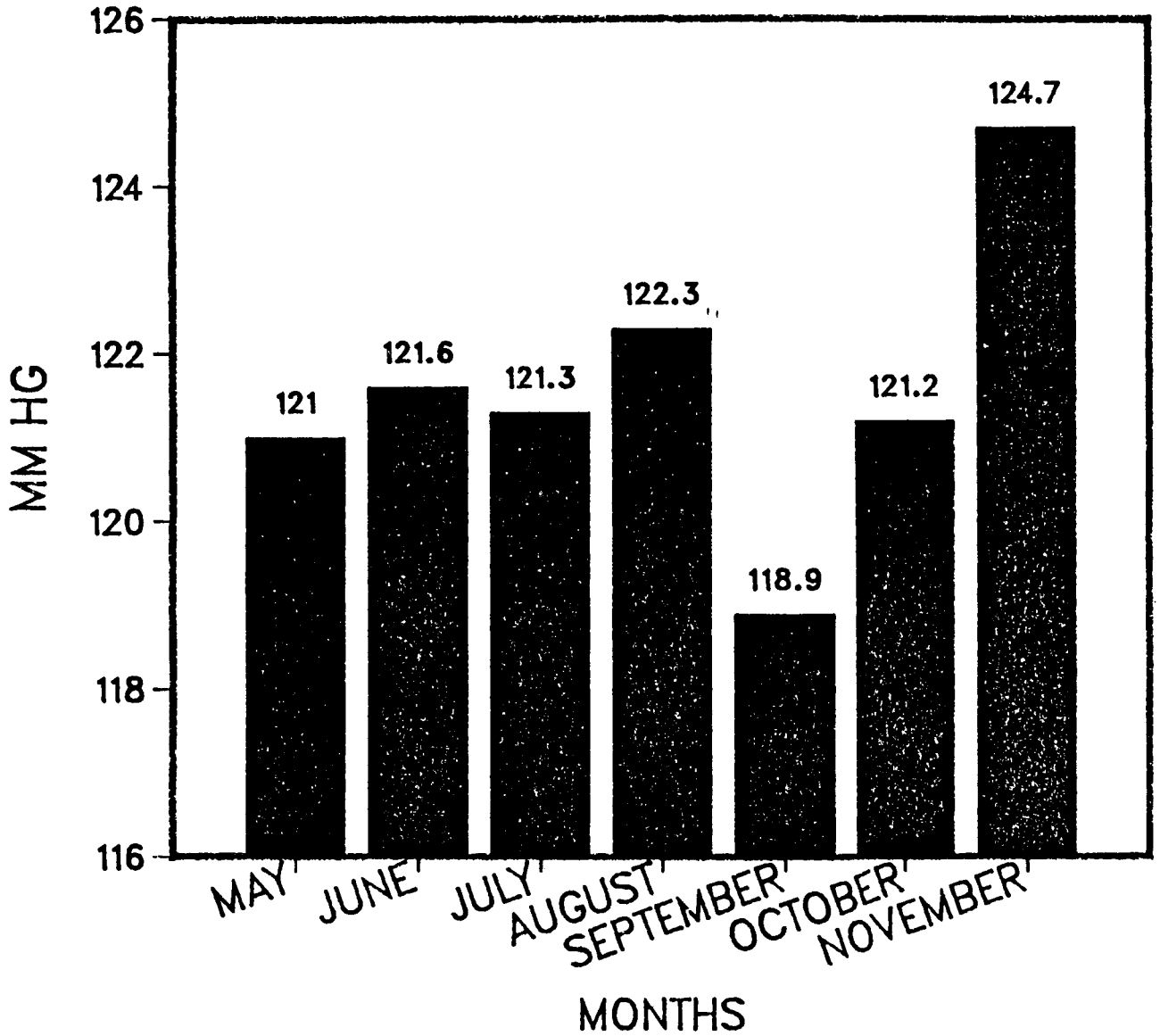


FIGURE 2A: EPINEPHRINE LEVELS OVER THE WINTER

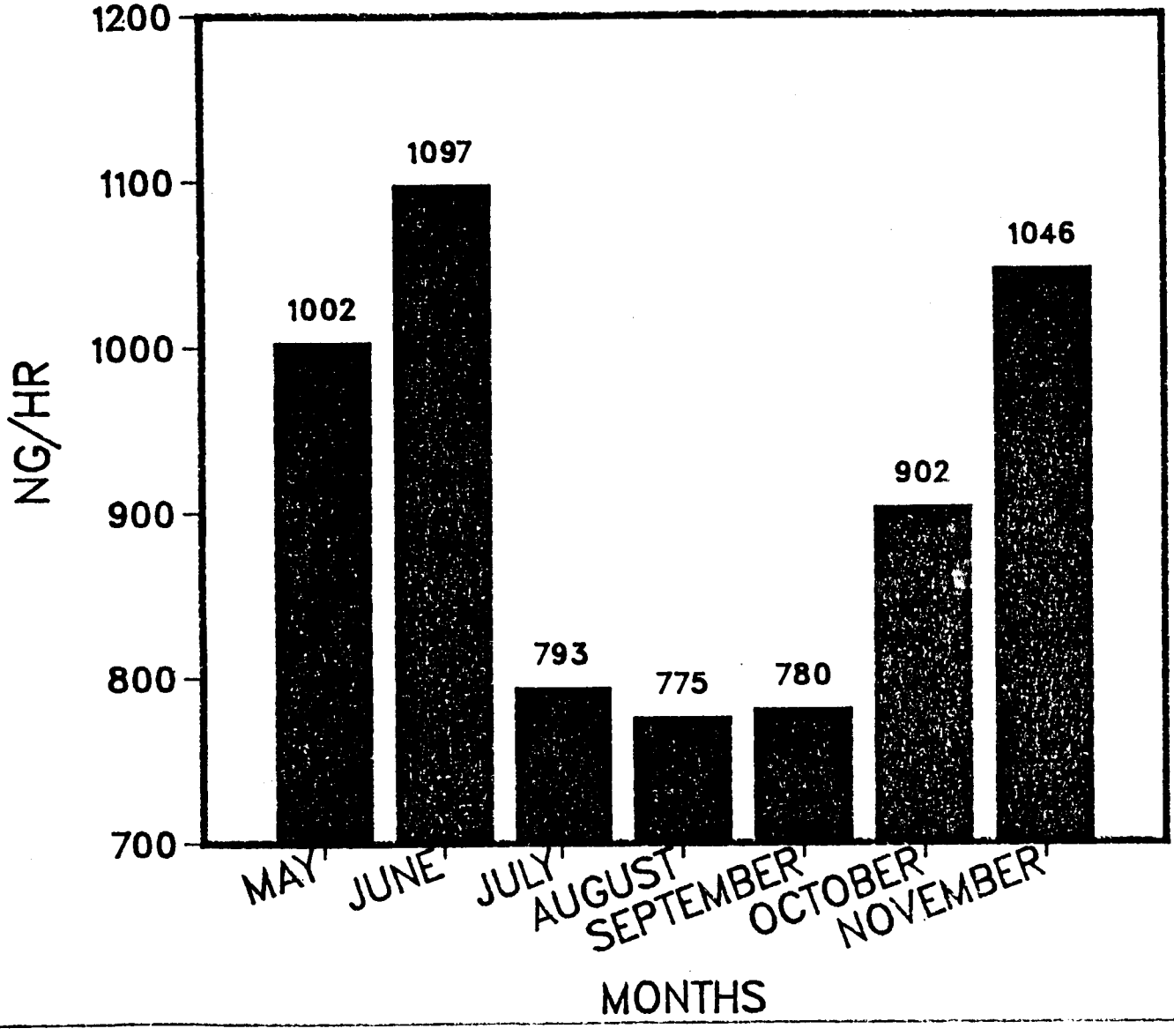


FIGURE 2B: NOREPINEPHRINE LEVELS OVER THE WINTER

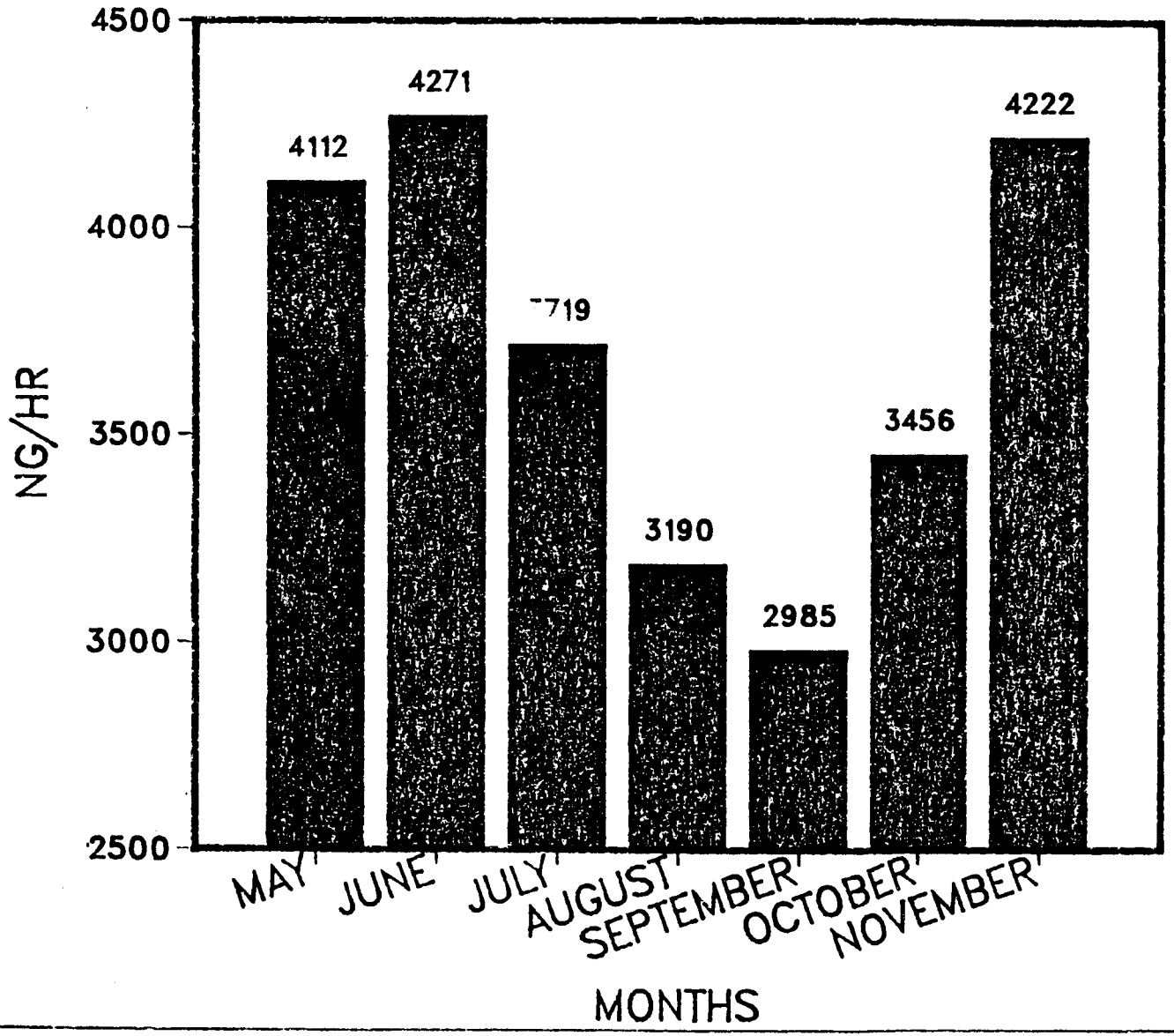


FIGURE 3: MOODS OVER THE WINTER MONTHS

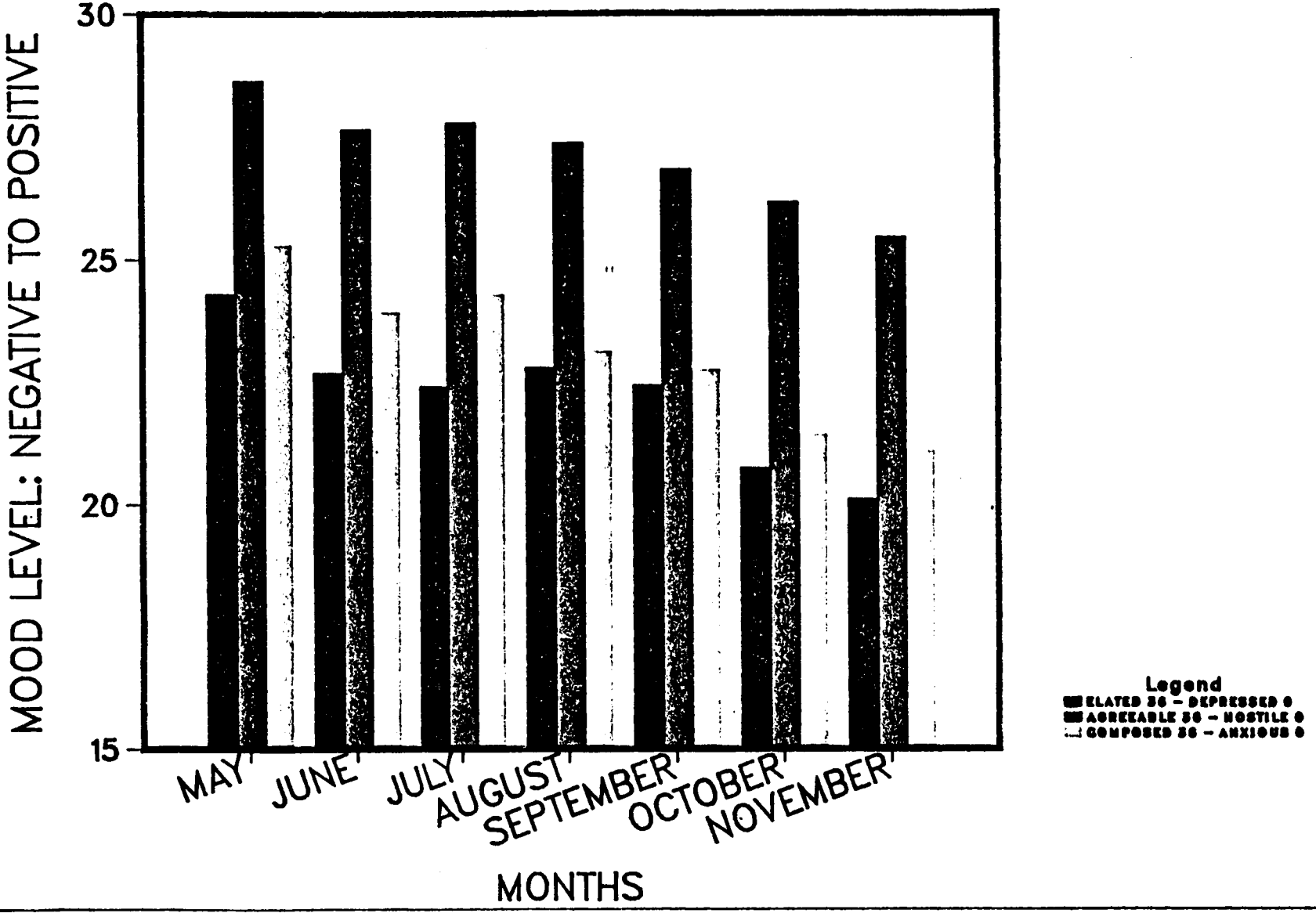
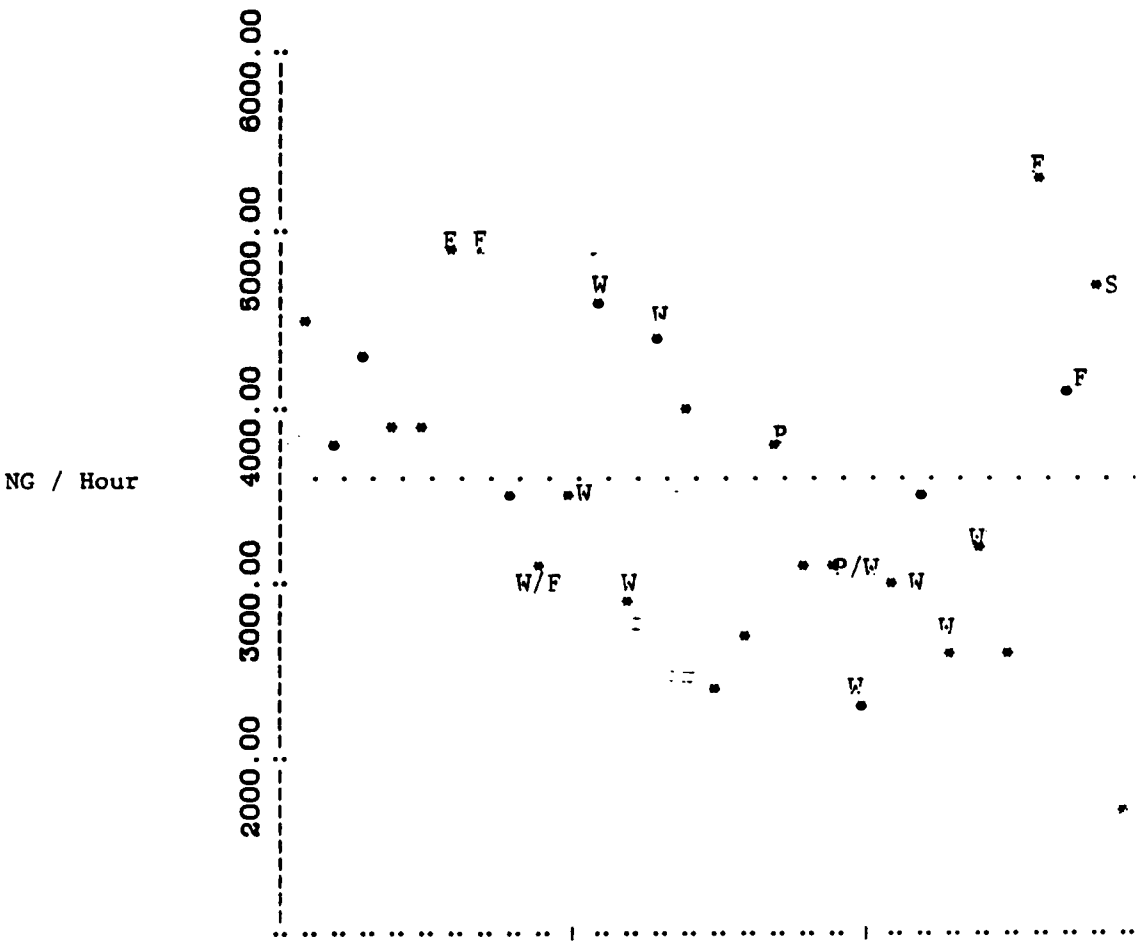


FIGURE 5: Plot of Norepinephrine Levels over the Antarctic Winter



OBS	DATA	
1	4493.76	Norepinephrine levels for each observation
2	3784.43	
3	4298.06	
4	3874.47	
5	3857.53	
6	4867.98	
7	4851.91	
8	3505.21	
9	3137.01	
10	3488.32	
11	4591.39	
12	2883.82	
13	4394.82	
14	3966.79	
15	2358.47	
16	2699.30	
17	3835.82	
18	3144.98	
19	3073.59	
20	2273.35	
21	2959.46	
22	3541.34	
23	2603.88	
24	3206.65	
25	2625.40	
26	5281.97	
27	4076.21	
28	4688.64	
29	1651.05	

Time ordered observations

/ May / June / July /August / Sept. / Oct. / November

LEGEND:

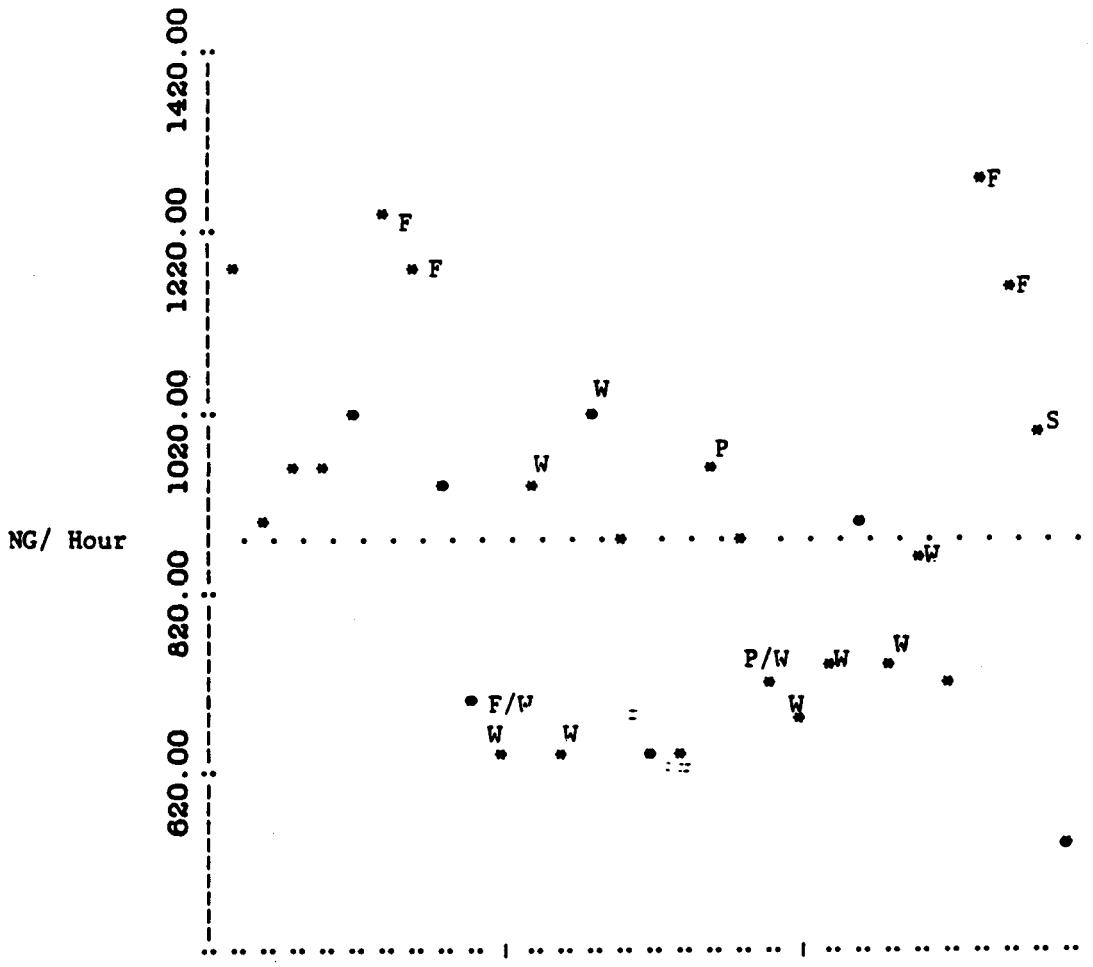
F = Festivities

S = Summer Ship Arrives

W = Strong Winds

P = R/V Polar Duke Winter Cruise at Station

FIGURE 6: Plot of Epinephrine Levels over the Antarctic Winter



OBS	DATA	
1	1187.41	Epinephrine levels for each observation
2	896.768	
3	968.828	
4	968.002	
5	1019.91	
6	1238.62	
7	1182.10	
8	946.236	
9	697.835	
10	843.043	
11	938.486	
12	848.089	
13	1018.62	
14	874.098	
15	634.801	
16	845.997	
17	956.421	
18	878.205	
19	714.721	
20	677.853	
21	731.145	
22	906.171	
23	735.304	
24	857.311	
25	713.782	
26	1279.01	
27	1188.93	
28	996.509	
29	843.133	

/ May / June / July / August / Sept. / Oct. / November

Time ordered observations

LEGEND:

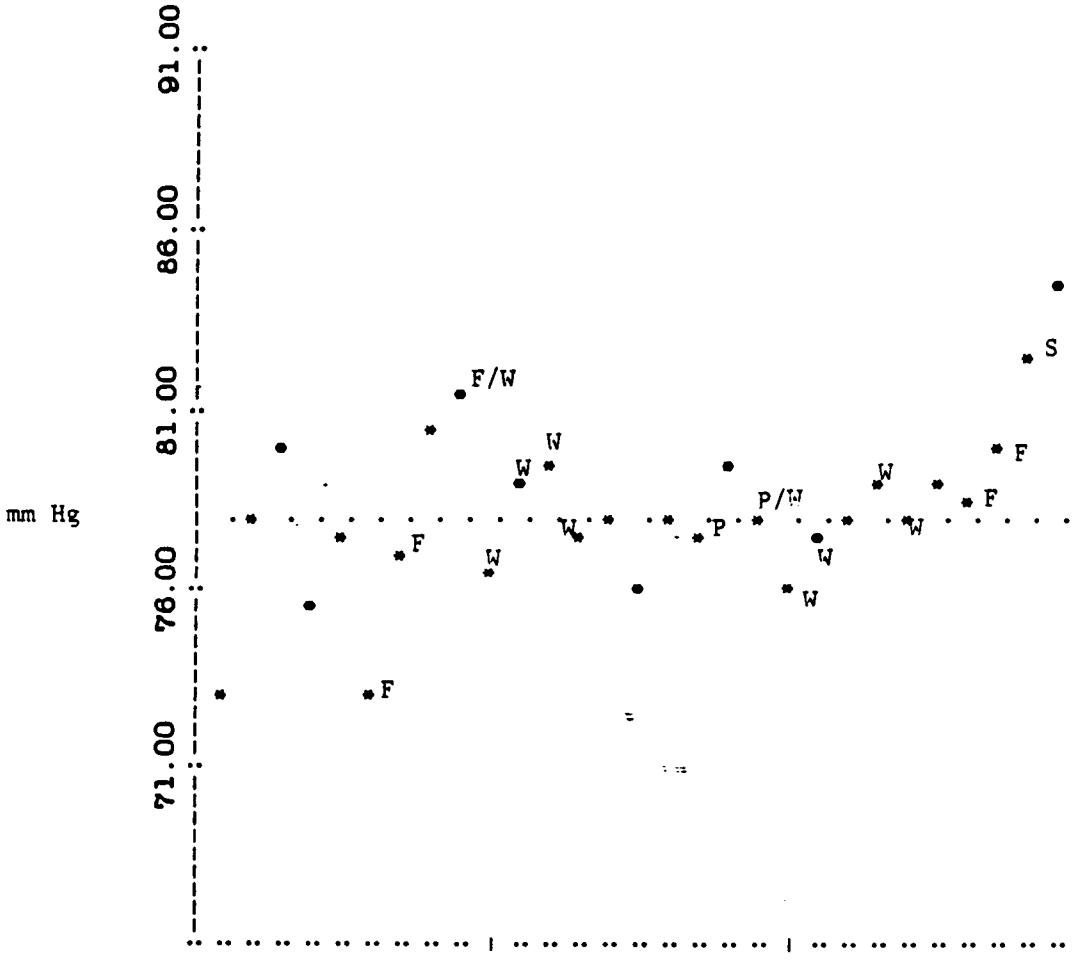
F = Festivities

W = Strong Winds

S = Summer Ship Arrives

P = R/V Polar Duke Winter Cruise at Station

FIGURE 7: Plot of Diastolic Blood Pressure over the Antarctic Winter



OBS	DATA	
1	72.9444	Diastolic Blood Pressure levels for each observation
2	77.8889	
3	80.0000	
4	75.4444	
5	77.5556	
6	73.0000	
7	76.8889	
8	80.6556	
9	81.6667	
10	76.5556	
11	78.8889	
12	79.6556	
13	77.3333	
14	78.0000	
15	76.0000	
16	78.1111	
17	77.4444	
18	79.3333	
19	77.8889	
20	76.1111	
21	77.5000	
22	78.2353	
23	79.0000	
24	77.8824	
25	78.7778	
26	78.5556	
27	79.8889	
28	82.5882	
29	84.5000	

Time ordered observations

/May / June / July / August/ Sept. / Oct. / November

LEGEND:

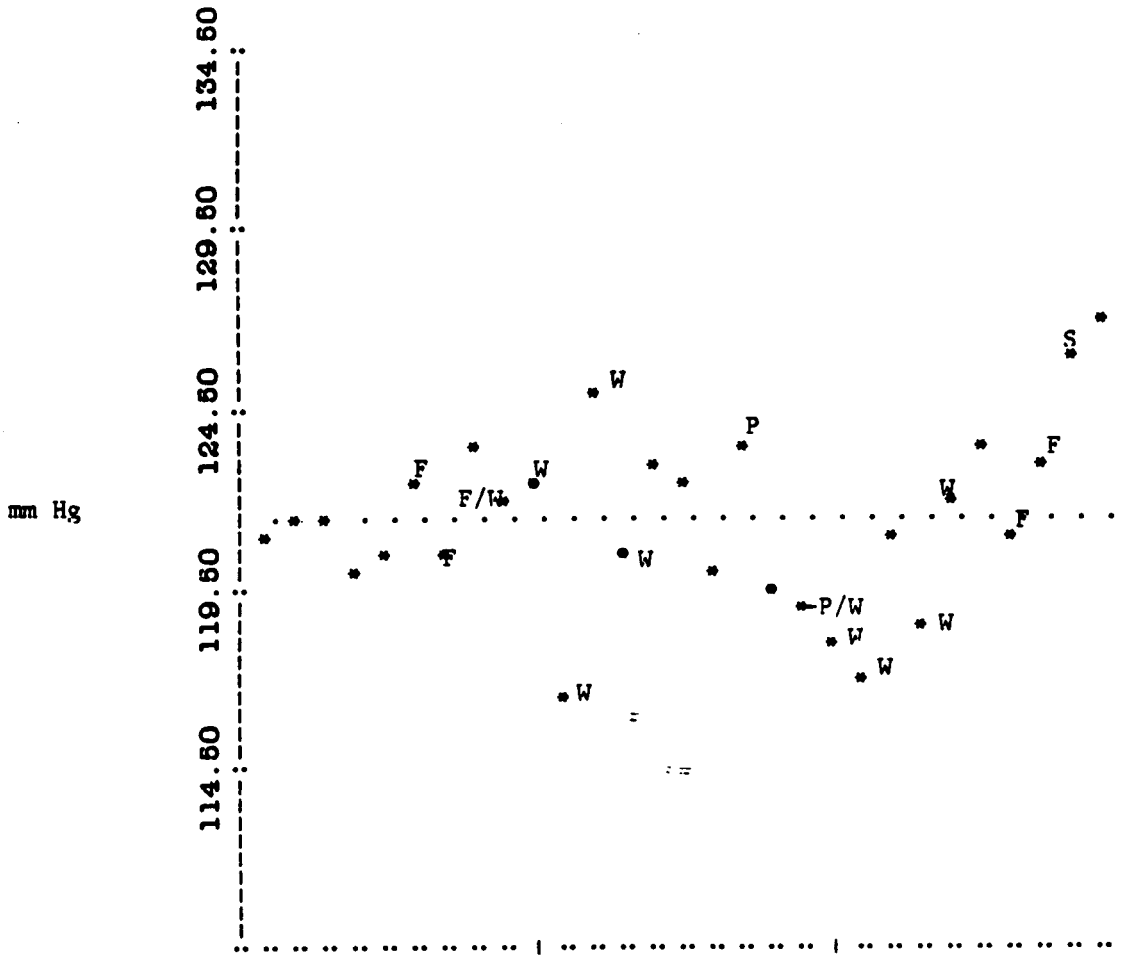
F = Festivities

W = Strong Winds

S = Summer Ship Arrives

P = R/V Polar Duke Winter Cruise at Station

Figure 8: Plot of Systolic Blood Pressure over the Antarctic Winter



OBS	DATA	
1	120.833	Systolic Blood Pressure for each observation
2	121.667	
3	121.611	
4	120.111	
5	120.444	
6	122.444	
7	120.333	
8	123.333	
9	121.889	
10	122.556	
11	116.667	
12	124.889	
13	120.667	
14	123.111	
15	122.667	
16	119.778	
17	123.444	
18	119.556	
19	118.778	
20	117.778	
21	117.000	
22	121.059	
23	118.556	
24	122.118	
25	123.444	
26	120.889	
27	122.778	
28	126.118	
29	127.000	Time ordered observation

/ May / June / July / August / Sept. / Oct. / November

LEGEND:

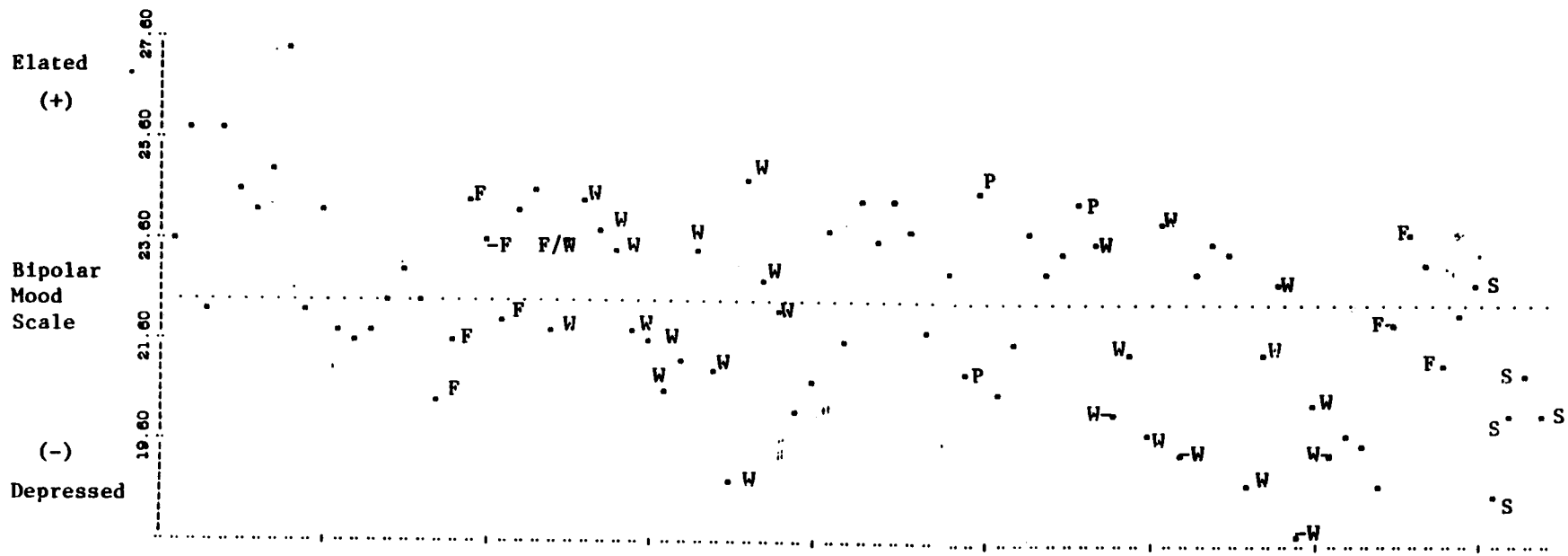
F = Festivities

W = Strong Winds

S = Summer Ship Arrives

P = R/V Polar Duke Winter Cruise at Station

Figure 9: Plot of the Mood Scores on the POMS Bipolar Depression - Elation Scale over the Antarctic Winter



OBS	DATA	Mood Scores
1	25.5714	
2	25.7778	
3	22.1111	
4	25.7778	
5	24.5556	
6	24.2222	
7	25.0000	
8	27.4444	
9	22.2222	
10	24.2222	
11	21.7778	
12	21.5556	
13	21.7778	
14	22.3750	
15	23.0000	
16	22.3333	
17	20.4444	
18	21.6667	
19	24.4444	
20	23.5556	
21	22.0000	
22	24.2222	
23	24.6667	
24	21.8889	
25	23.6667	
26	24.4444	
27	23.7778	
28	23.4444	
29	21.8889	
30	21.5556	
31	20.5556	
32	21.1111	
33	23.3333	
34	21.0000	
35	18.8750	
36	24.7778	
37	22.8889	
38	22.2500	
39	20.2222	
40	20.7778	
41	23.7500	
42	21.5556	
43	24.4444	
44	23.6667	
45	24.4444	
46	23.8889	
47	21.8889	
48	23.0000	
49	21.0000	
50	24.6667	
51	20.6667	
52	21.6667	
53	23.8889	
54	23.0000	
55	23.4444	
56	24.4444	
57	23.5556	
58	20.1111	
59	21.3750	
60	19.8571	
61	24.0000	
62	19.4286	
63	23.0000	
64	23.5000	
65	23.3750	
66	18.8571	
67	21.3750	
68	22.8889	
69	17.7778	
70	20.4444	
71	19.3333	
72	19.7500	
73	19.5000	
74	18.8571	
75	22.0000	
76	23.8889	
77	23.2222	
78	21.2857	
79	22.2222	
80	22.8750	
81	18.5000	
82	20.1429	
83	21.0000	
84	20.2500	

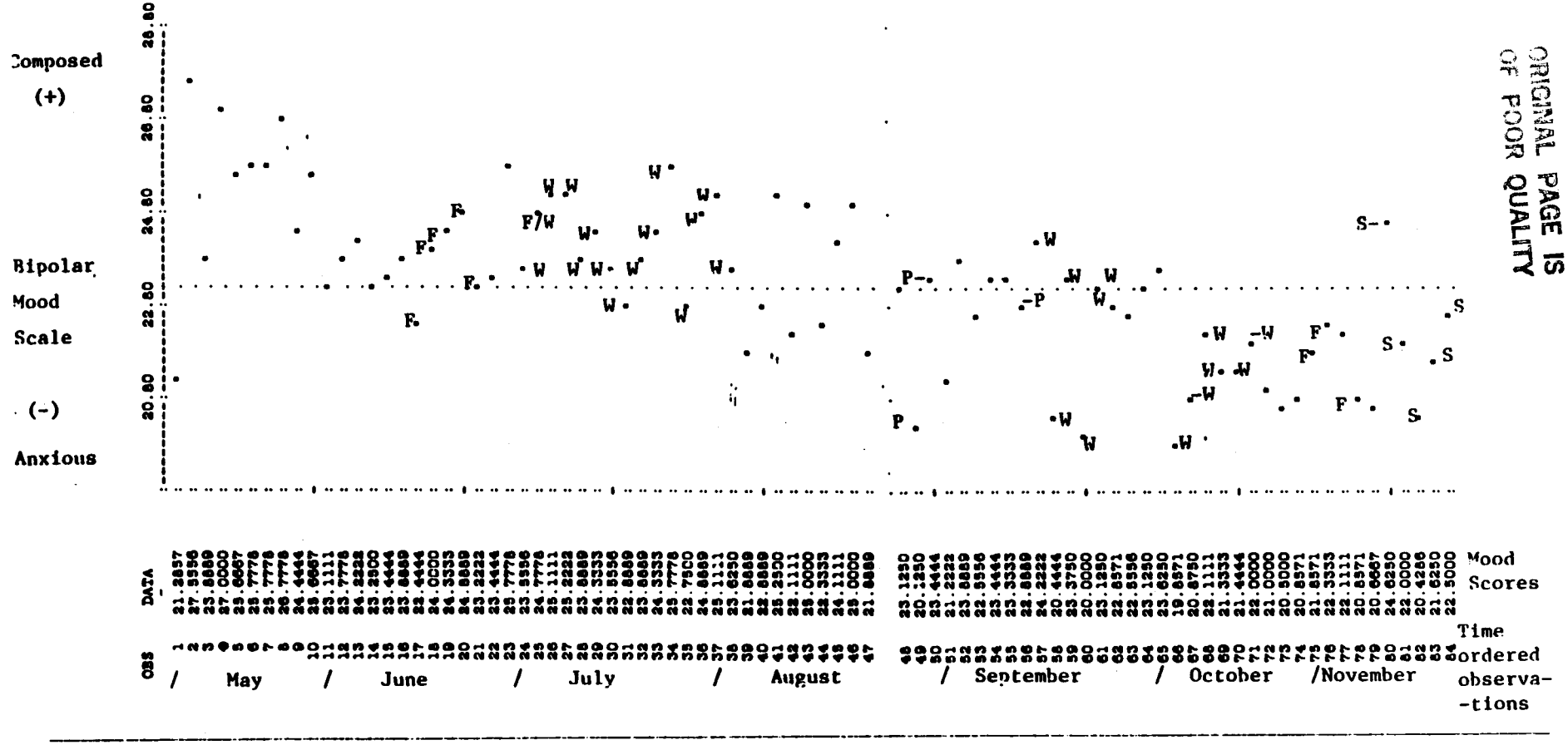
/ May / June / July / August / September / October / November

Time ordered observa-tion

LEGEND:

F = Festivities W = Strong Winds S = Summer Ship Arrives P = R/V Polar Duke Winter Cruise at Station

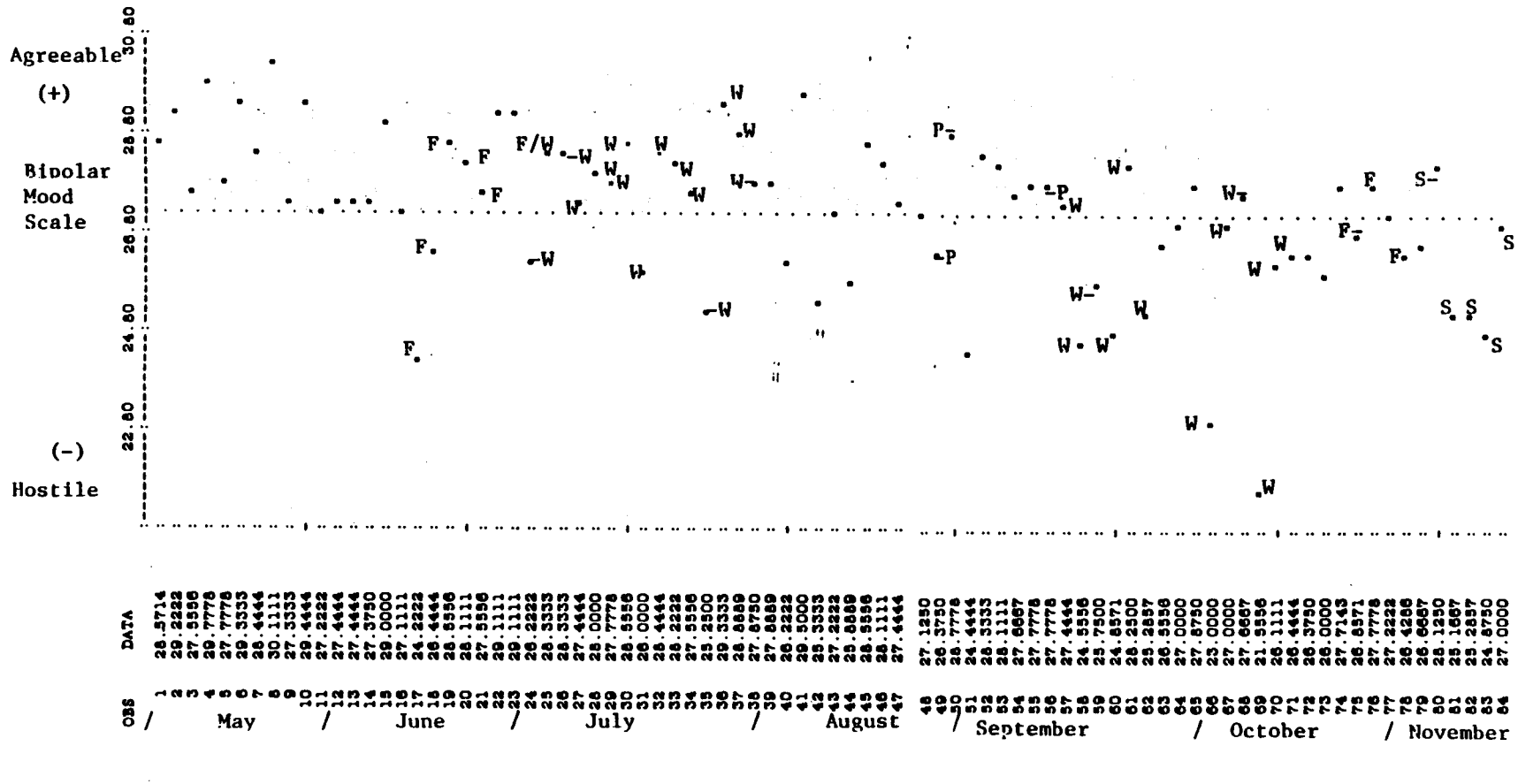
Figure 10: Plot of the Mood Scores on the POMS Bipolar Anxious - Composed Scale over the Antarctic Winter



LEGEND:

F = Festivities W = Strong Winds S = Summer Ship Arrives P = R/V Polar Duke Winter Cruise at Station

Figure 11: Plot of the Mood Scores on the POMS Bipolar Hostile - Agreeable Scale over the Antarctic Winter



LEGEND:

F = Festivities W = Strong Winds S = Summer Ship Arrives P = R/V Polar Duke Winter Cruise at Station

FIGURE 12: TYPES OF ACTIVITIES PARTICIPATED IN OVER TIME

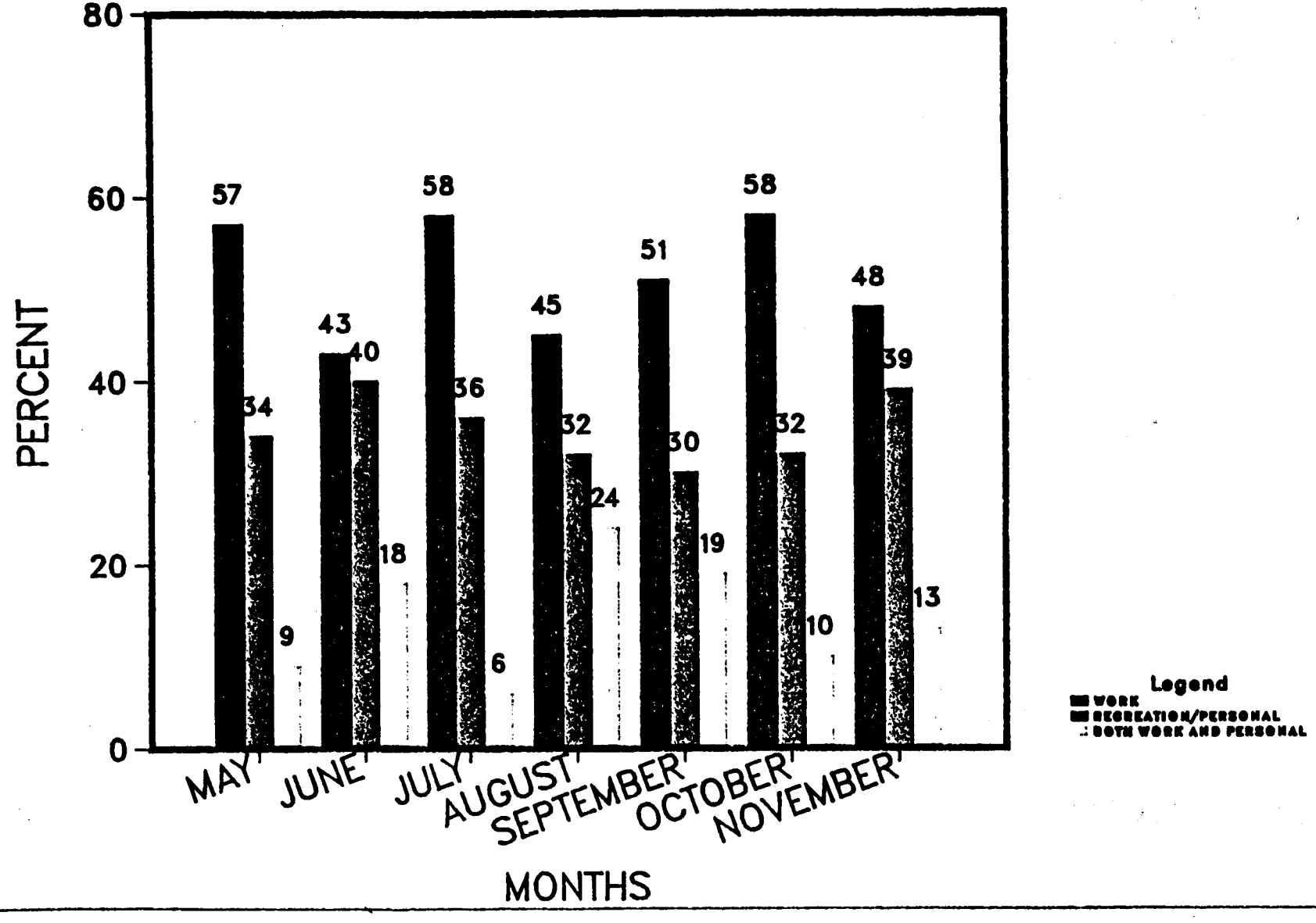
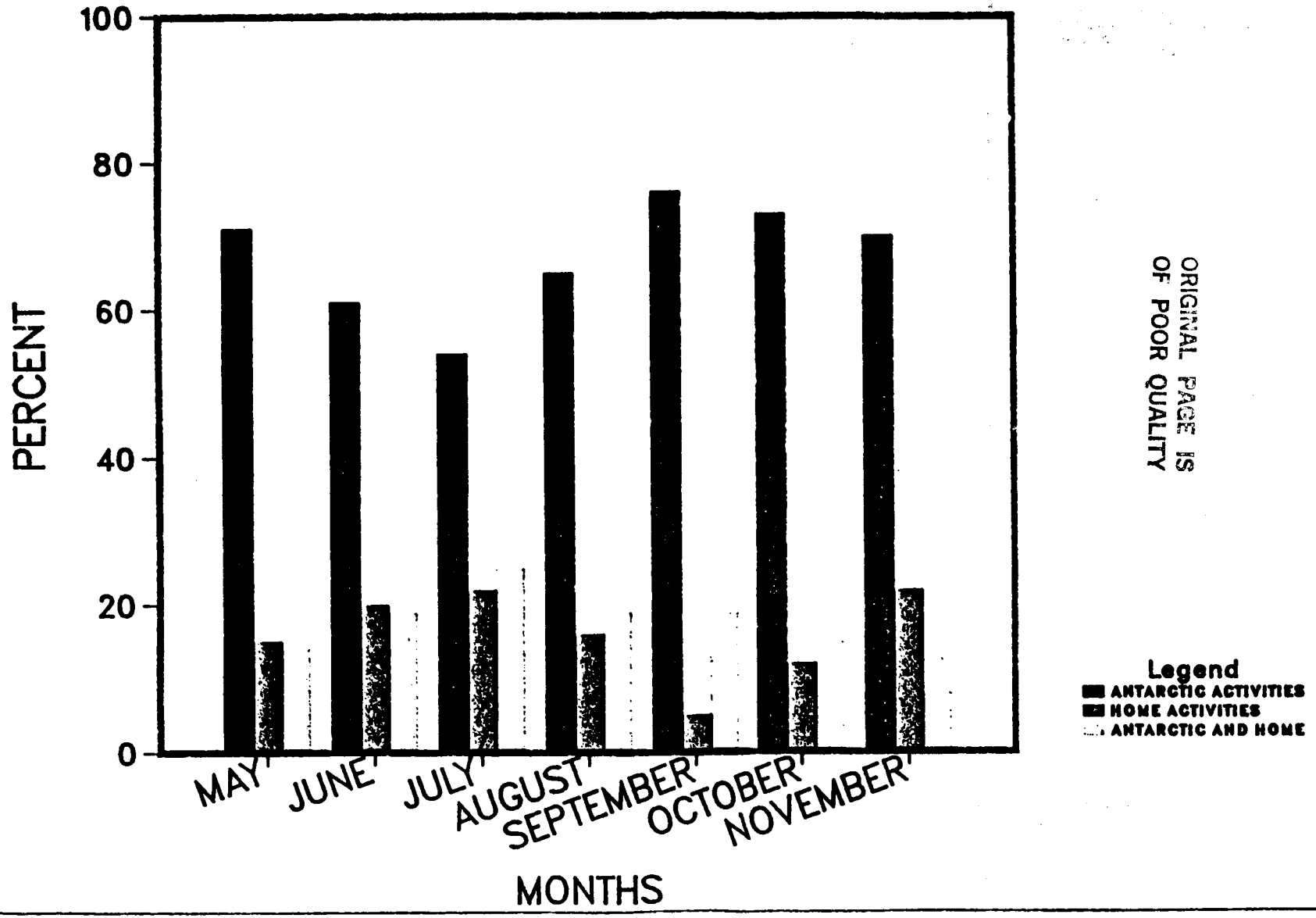
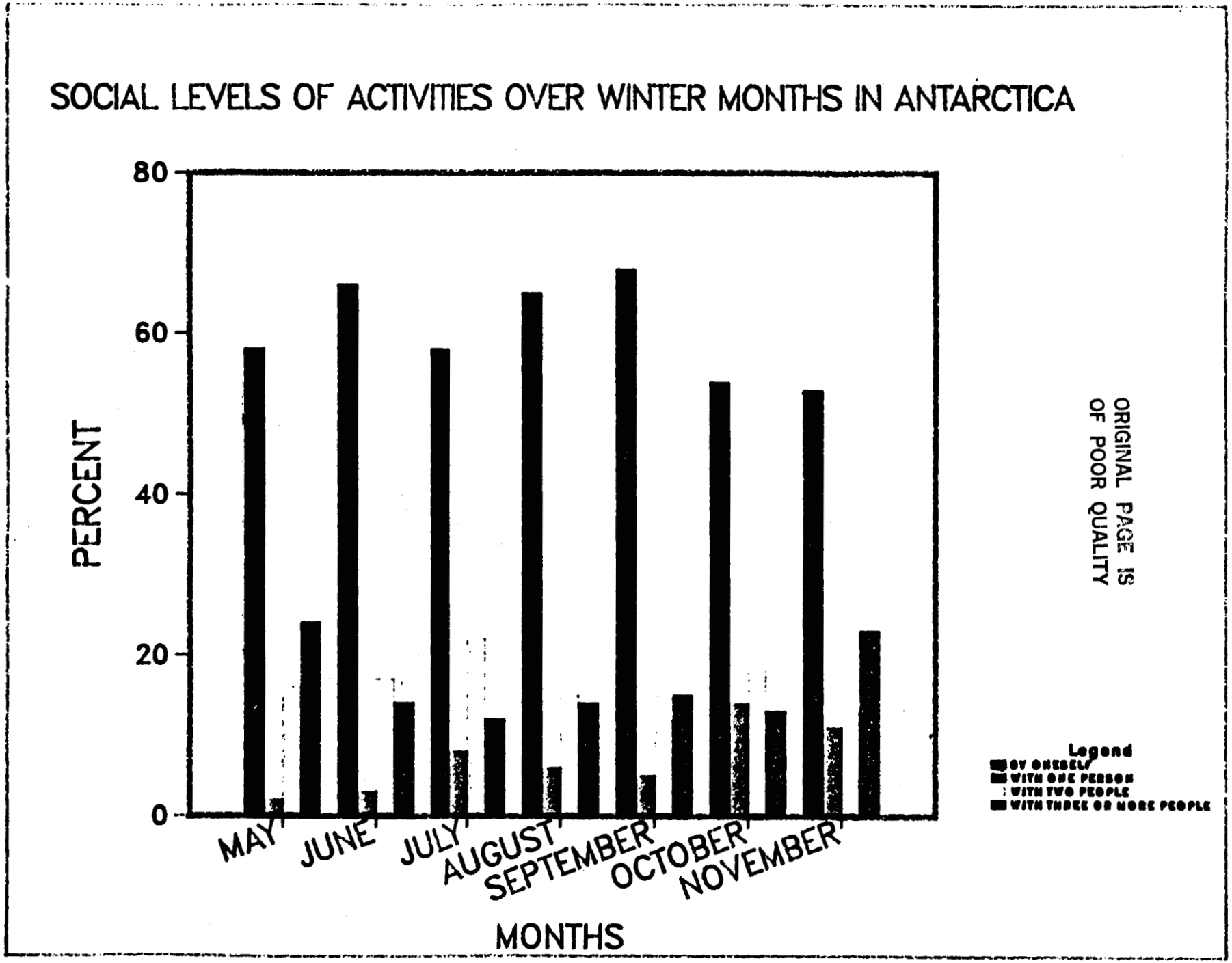
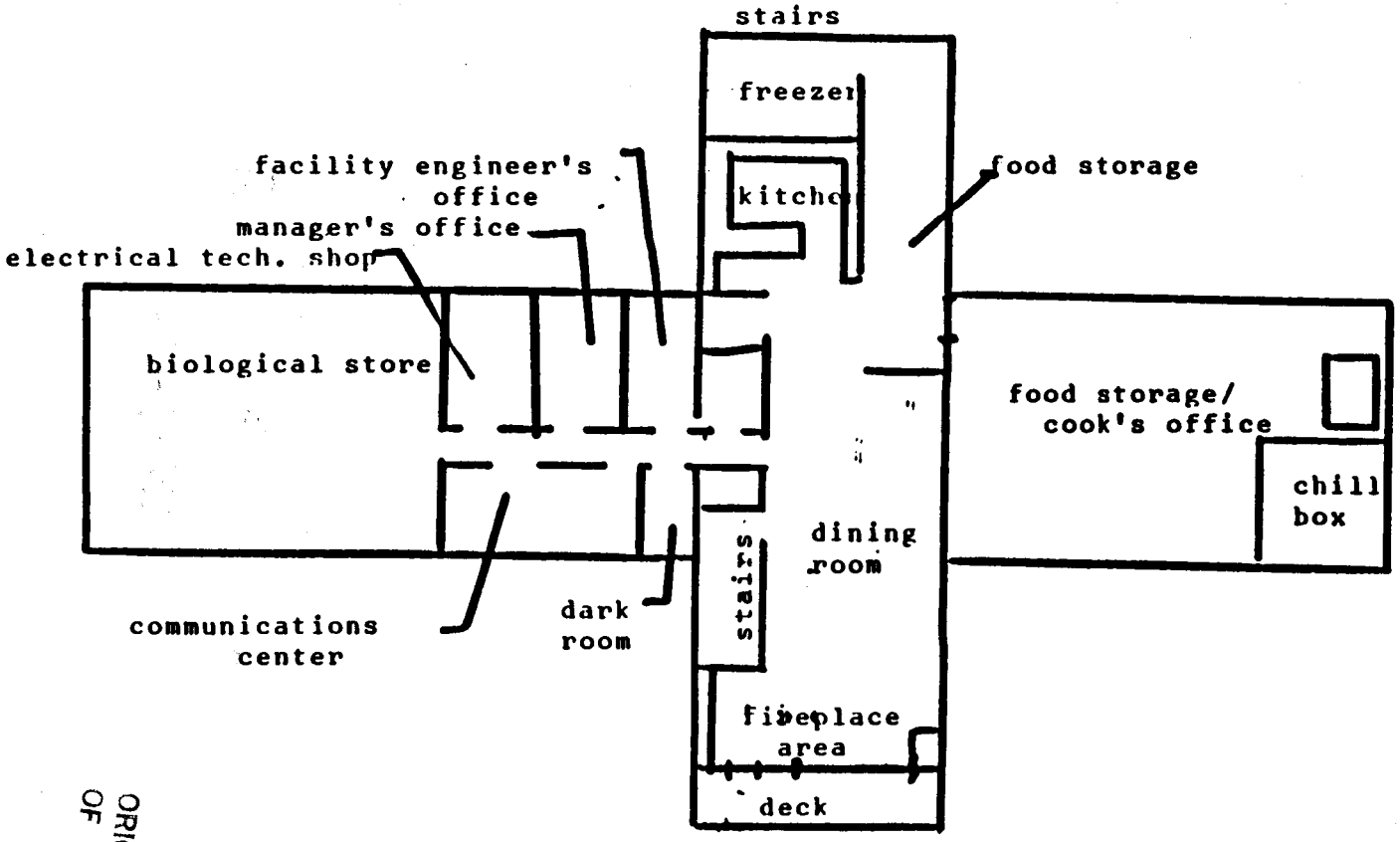


FIGURE 13: ORIENTATION OF THE ACTIVITIES OVER THE WINTER

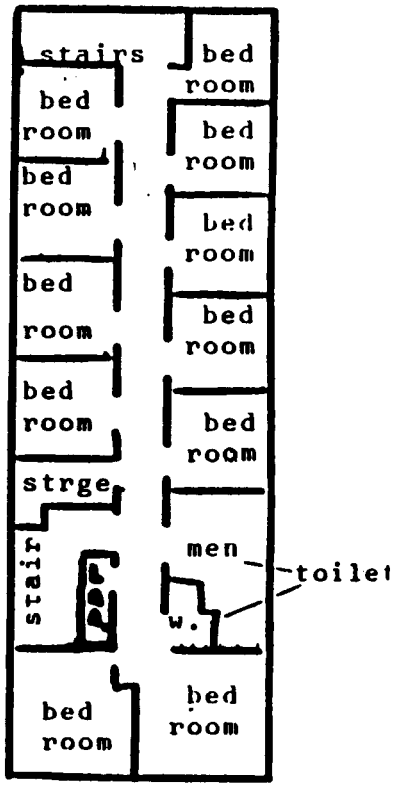




BIOLOGICAL BUILDING

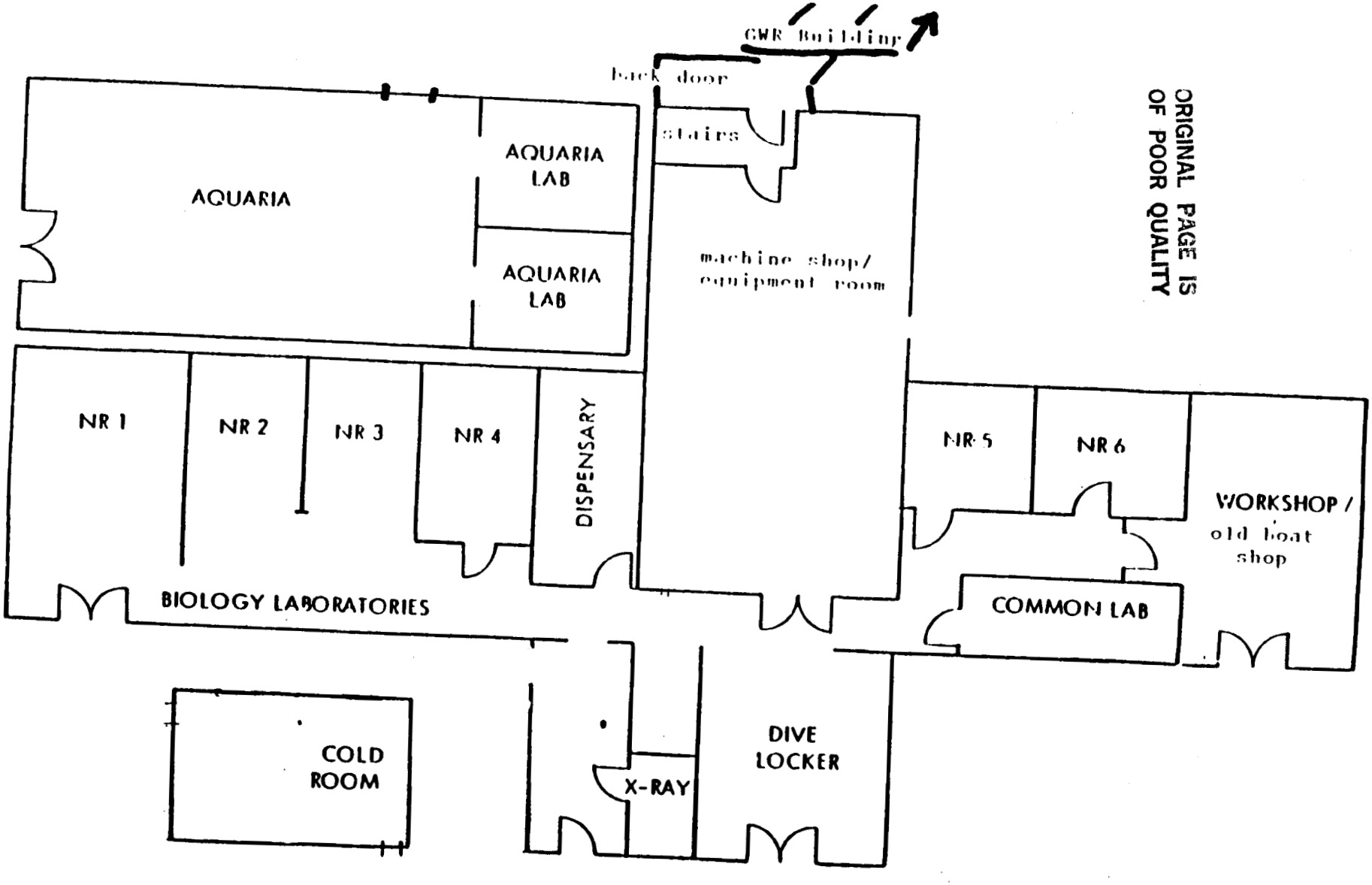


SECOND FLOOR



THIRD FLOOR

FIGURE 2



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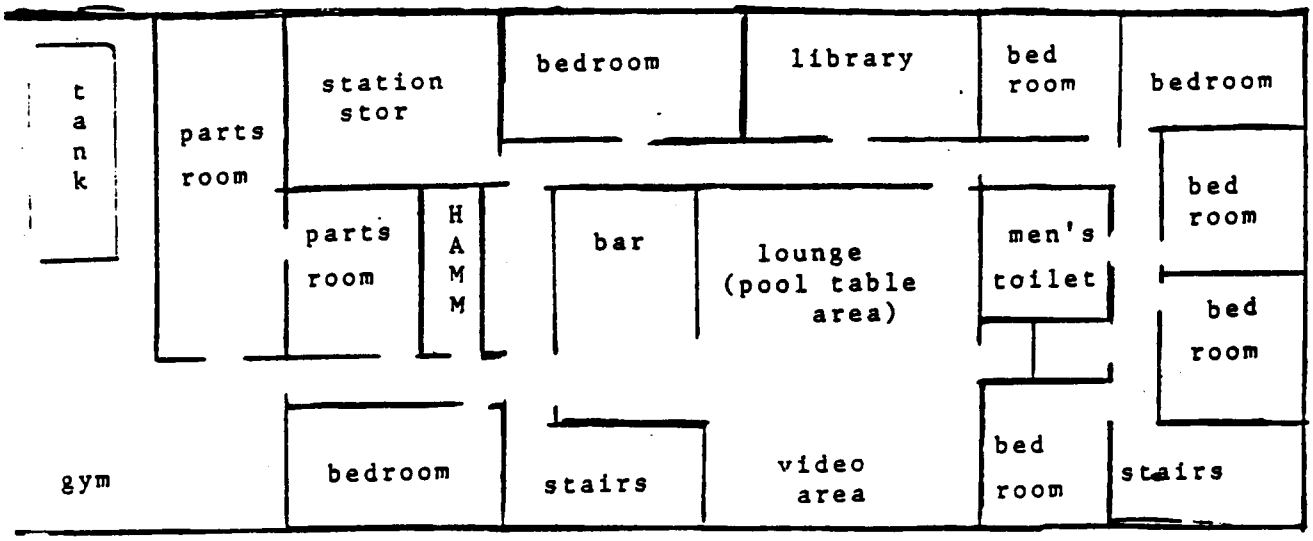
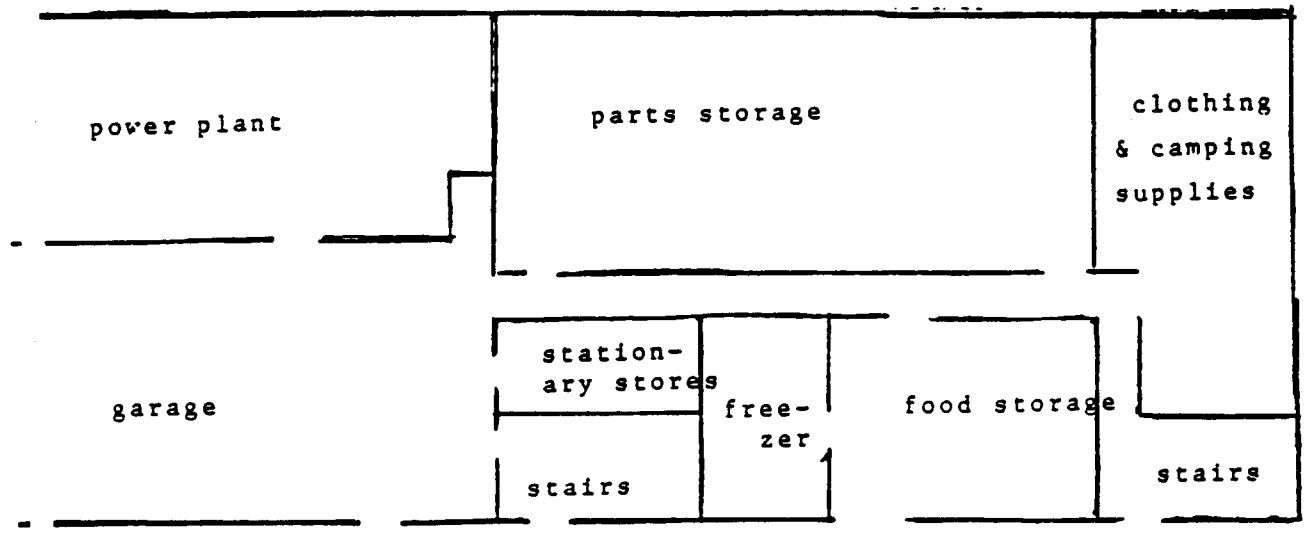
BIO LAB BUILDING -- GROUND FLOOR PLAN



GWR BUILDING SECOND FLOOR



GWR BUILDING - FIRST FLOOR

GARAGE, WAREHOUSE, RECREATION

(GWR)

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16. Abstract This field study was conducted during the last decade of an austral winter-over at Palmer Station in the Antarctic. The purpose of the study was to understand temporal patterns in physiological arousal and psychological mood over the course of the mission. The investigators were principally interested in how people adapted over time to chronic and acute stressors, and how people use and modify their built environment. Physiological and psychological data were collected several times a week, and information on behavior and the use of physical facilities was collected monthly. Physiological and psychological data were compared with social changes in the setting toward the development of a sequential model of human-environment transactional relationships. Based on the study results, guidelines for design of future isolated and confined environments (ICEs) included: plan space for items which make people feel at home, provide materials to allow people to personalize their environment, allow for flexible environments, provide areas for visual and auditory privacy, equip areas for socializing and remove them from private areas, and provide facilities for exercise and for projects involving physical activity. The study offers guidelines about patterns of adaption that could be expected in an ICE, discusses how these settings can be programmed to facilitate successful adjustment, and provides information about how to design future ICE habitats to maximize a healthy living environment.

17. Key Words (Suggested by Author(s))

Isolated and confined environment (ICE), epinephrine, norepinephrine, depression, hostility, chronic stressors, behavioral adjustment, anxiety, personalization, flexible environments, privacy, recreational areas, social areas

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