U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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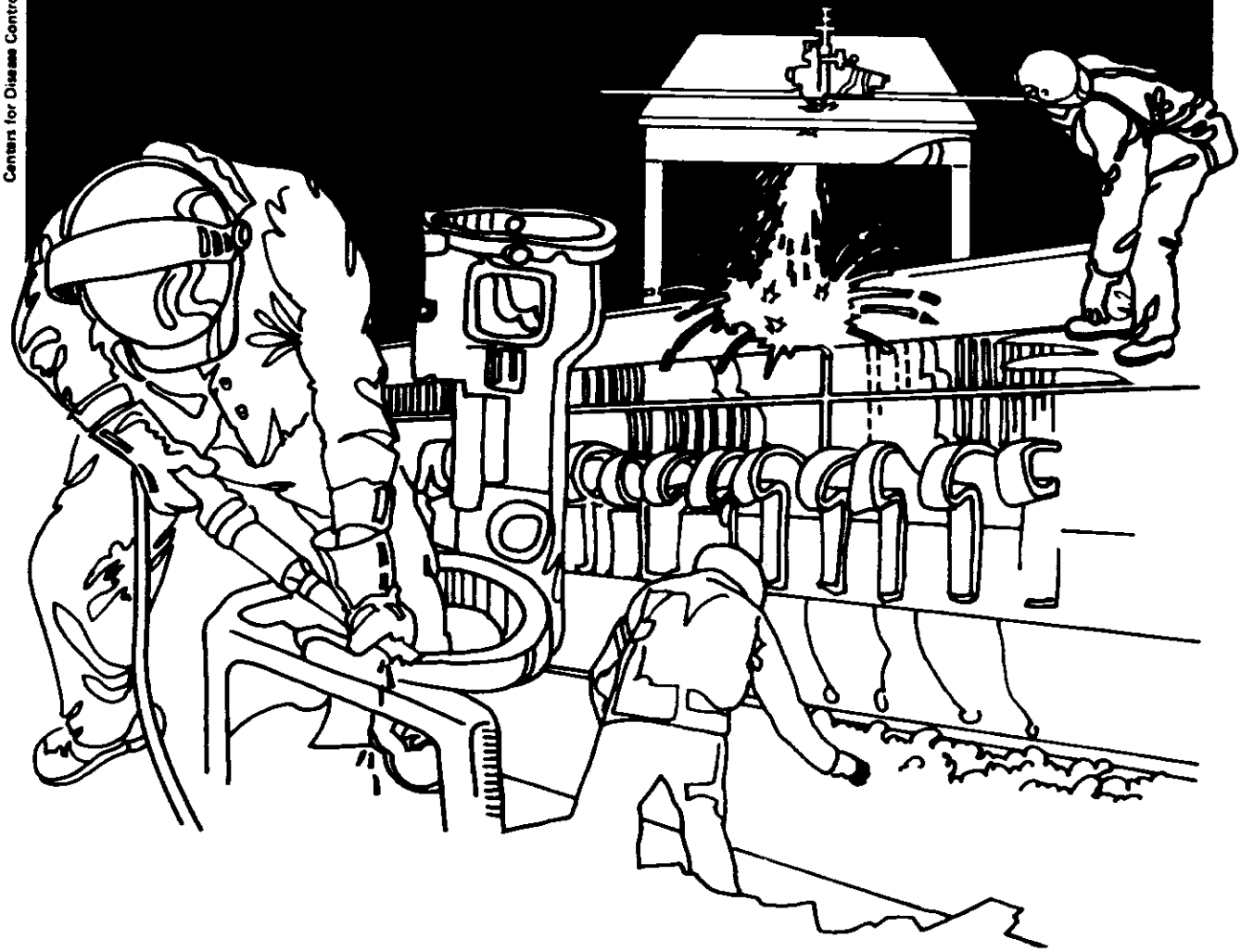

Health Hazard Evaluation Report

HETA 86-372-1796
NATIONAL MARINE FISHERIES SERVICE
U.S. DEPARTMENT OF COMMERCE
PASCAGOULA, MISSISSIPPI

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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May 1987
NATIONAL MARINE FISHERIES SERVICE
U.S. DEPARTMENT OF COMMERCE
PASCAGOULA, MISSISSIPPI

NIOSH INVESTIGATORS:
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I. SUMMARY

On May 20, 1986, the National Institute for Occupational Safety and Health (NIOSH) received a request from the U.S. Department of Commerce to evaluate an ongoing mold/mildew problem at the National Marine Fisheries Service (NMFS), Southeastern Regional office in Pascagoula, Mississippi. Symptoms reported by the office workers included itchy eyes, sneezing, coughing, and throat irritation.

The mold problem started in 1983 shortly after the NMFS staff of about 50 workers moved into a 10,000 sq. ft. new wing of the single story National Oceanic and Atmospheric Administration (NOAA) building. The mold/mildew growth was directly attributable to moisture incursion and high humidity conditions resulting from improperly installed components of an all-water heating, ventilating, and air conditioning (HVAC) system utilizing ceiling fan coil units. During the worst conditions, when relative humidity was high, mold/mildew growth was observed on virtually every surface in the new wing, including ceiling tiles, furniture, books, and walls. Because repair of the HVAC system and cleanup did not appear to be imminent (funds were held-up in litigation), in the summer of 1985 NMFS started using portable dehumidifiers as an interim control measure to reduce the humidity in the new wing.

On May 22, 1986, we visited the facility and observed that even though the dehumidifiers were effective in suppressing much of the microbial growth, many surfaces were still visibly contaminated. Qualitative analysis of wipe and bulk samples documented the presence of fungal and bacterial contamination. Based on this information, we decided to conduct a follow-up environmental and medical evaluation to measure airborne levels of viable microorganisms and to characterize the types of health complaints workers had been experiencing.

On September 16 and 17, 1986, air samples for viable microorganisms were collected from three sites in each of the new and old wings of the NOAA building, one site in the Danzler building (a control site), and from one site outdoors. Airborne levels of total viable microorganisms (TVM) (representing the sum total of 25°C fungi, 50°C thermophilic actinomycetes, and 35°C bacteria) averaged 1,236 colony-forming units per cubic meter of air (CFU/M^3) in the new wing. Acremonium sp. was by far the most abundant fungal species isolated; airborne levels in the new wing averaged 875 CFU/M^3. Although no evaluation criteria

currently exists for airborne microbial contamination, the ACGIH Committee on Bioaerosols has proposed a TVM count of 10,000 CFU/M^3 or more, or colony counts of any one species of fungus, actinomycete, or bacteria in excess of 500 CFU/M^3 as necessitating remedial actions. TVM levels in the old wing, an area with a similar ventilation system as the new wing, but without moisture-incursion problems, averaged 701 CFU/M^3, while levels in the Danzler building and outdoors were measured at 138 and 698 CFU/M^3, respectively. In each of these areas the concentrations of isolated fungal species did not exceed 500 CFU/M^3, although this criterion was exceeded for Bacillus sp. in one of the three sampling sites in the old wing. Levels of thermophilic actinomycetes were low in all of the air samples.

On September 29, 1986, a medical symptom questionnaire was administered to employees. Occupationally-related symptoms were defined based on the reported frequency, duration, seasonality, and onset of symptoms. Any employee reporting at least one of eight work-related respiratory symptoms from October 1985 to September 1986 was considered a case of illness. The four lower respiratory cases identified worked in the new wing and were former smokers. These associations were not statistically significant. Ten upper respiratory cases were identified, associated with reports of smelling odors and a history of pneumonia or other chest illness.

On the basis of the data obtained during this investigation we concluded that, despite the implementation of interim control measures, concentrations of airborne fungi in the new wing of the NOAA building were in excess of the proposed ACGIH criteria and that these levels had probably been higher in the past, before use of the dehumidifiers. Despite the increase in airborne fungal levels in the new wing, no statistically significant association was identified between exposure to the new wing and illness. Recommendations for additional remedial actions are presented in Section VIII of this report.

KEYWORDS: SIC 9512 (Land, Mineral, Wildlife, and Forest Conservation), indoor air quality, mold, mildew, microbiological contamination, viable air sampling.

II. INTRODUCTION

On May 20, 1986, the National Institute for Occupational Safety and Health (NIOSH) received a request from a safety officer with the U.S. Department of Commerce to evaluate a mold/mildew problem at the National Marine Fisheries Service (NMFS) Southeastern Regional office in Pascagoula, Mississippi. Symptoms reported by workers included itchy eyes, coughing, sneezing, and throat irritation.

On May 22, 1986, an initial survey was conducted by a NIOSH industrial hygienist, during which a walkthrough inspection was made and pertinent background information gathered. Environmental sampling was limited to the collection of bulk and surface wipe samples for identification of microorganisms. On July 17, 1986, a letter summarizing the results of this survey, and containing recommendations to improve the office environment was sent to NMFS.

On September 16 and 17, 1986, a follow-up environmental survey was conducted to measure levels of airborne viable microorganisms, and on September 29, a follow-up medical survey was conducted to characterize the types of health complaints workers had been experiencing.

III. BACKGROUND

A. General

The NMFS, a division of the National Oceanic and Atmosperic Administration (NOAA), conducts research to improve and preserve commercial and sport fishing. The office in Pascagoula, Mississippi, employs approximately 45 people, including administrative, clerical, and field personnel, and is located in the 10,000 sq. ft. new wing of a 20,000 sq. ft. single story building (hereafter referred to as the NOAA building). The old wing, built in 1957, is occupied by approximately 10 to 15 employees of the National Seafood Inspection Laboratory, along with about 10 support staff of NMFS, and consists of both laboratories and offices.

B. Ventilation

Both the new and the old wings of the NOAA building are heated and cooled by all-water heating, ventilating, and air conditioning (HVAC) systems which are independent of one another. Each system utilizes a number of fan coil units which are located on the ceiling of each individual office and lab. Each fan coil unit is provided with either warm or chilled water depending on whether the work space is to be heated or cooled. During the heating season warm water is piped into the units, and the work space is heated by passing air over the water-heated coils. By contrast, during the

cooling season the fan coil units are provided with cool water which essentially "extracts" heat from the work area resulting in lower air temperature. Dehumidification of the air accompanies this process; water condensed from the cooling coils is collected in a condenser pan and is drained outdoors.

The two wings are connected by a common reception area and by a door-partitioned hallway in the back of the building. The ventilation system was designed to maintain the new wing under slight positive pressure relative to the old wing.

C. Problem Description

The mold/mildew problem reportedly developed shortly after NMFS moved into the new wing in 1983. Unfortunately, the problem could not be rectified because cleanup funds were held up in litigation. The problem was directly attributable to deficiencies in the ventilation system (i.e., improperly installed pipe insulation and condenser pan drainage lines for the fan coil units). These deficiencies resulted in water damage to numerous ceiling tiles and in high humidity conditions which led to mold/mildew formation on various surfaces throughout the new wing. During the worst conditions, when relative humidity was in excess of 95% during the summer months, mold/mildew was observed on virtually all surfaces in the office, including furniture, books, walls, and ceiling tiles. The microbial contamination was so extensive that it was present on interwall surfaces. As an interim control measure, in the summer of 1985, NMFS purchased portable dehumidifiers to reduce the humidity in the new wing. Frequent cleaning of various non-porous work surfaces with disinfectant was also conducted to mitigate microbial growth. At the time of our initial survey in May, 20 dehumidifiers, positioned throughout the office area, were being used. NMFS personnel estimated that the dehumidifiers were collectively removing about 200 gallons of water a day. The dehumidifiers appeared to be effective in suppressing the spread of microbial growth, although many surfaces were still visibly contaminated at the time of our initial survey.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

1. Initial Survey

During the initial survey on May 22, 1986, 3 samples (2 surface wipe samples and one bulk sample of carpet) were collected for subsequent culturing and identification of fungi, and thermophilic actinomycetes. No culturing for bacteria was performed at this time. Both surface wipe samples were

collected by scraping material from ceiling tiles which were visibly contaminated with microbial growth. The carpet sample (a 2"X 2" piece) was cut from a remnant used as a floor mat by one of the office workers. All three samples were sent to a contract microbiology laboratory in Columbia, Missouri, for qualitative analysis. Upon receipt at the laboratory the samples were placed in sterile distilled water, then innoculated to appropriate media for isolation of fungi and actinomycetes.

2. Follow-up Survey

On September 16 and 17, 1986, viable air samples were collected for three classes of microorganisms: fungi, thermophilic actinomycetes, and bacteria. Air samples for these organisms were collected from three locations in the new wing (west, center, and east hallways). For purposes of comparison, viable air samples were also collected from three locations in the old wing (west, center, and north hallways), one location outdoors (north sidewalk), and from one location in the Danzler office building. This building, located across the street from the NOAA building, houses offices for several employees of the National Seafood Inspection Laboratory and reportedly did not have any problems with the ventilation system.

The sampling protocol and analytical procedures used in this evaluation were essentially consistent with those outlined by the ACGIH Committee on Bioaerosols.[1] All samples were collected on 100 mm x 15 mm plastic Petri dishes (plates) containing 45 ml of culture media. Air samples were collected by placing the agar plate into a single-stage Andersen viable air sampler, the agar surface being situated at a fixed distance from 400 0.25 mm diameter orifices through which ambient air is introduced. The sampler was connected to a vacuum pump calibrated to provide an air flow of 28.3 liters per minute (Lpm) through the sampler. The media used for the detection of fungi consisted of V-9 agar (a mixture of potato dextrose agar and V-8 juice).[2] Trypticase soy agar was the media used to detect both thermophilic actinomycetes and bacteria. Samples for each of these classes of microbes were collected for 1, 4, and 8 minutes at each location. "Bracketing" of sampling periods was done to ensure that at least one of the culture plates would contain colonies within a range suitable for accurate counting. To avoid potential cross-contamination of samples, the samplers were sterilized after each use. This was accomplished by immersing the samplers in 70% isopropanol for at least 1 minute and then allowing them to air dry. All culture plates were kept on ice

before and after use. At the completion of the site visit, the samples were placed into insulated shipping containers and sent via overnight express service to the same microbiology laboratory that analyzed the bulk samples.

Upon receipt at the lab, the samples were incubated. The temperature and duration of incubation was different for each of the three classes of microorganisms. Samples for fungi were incubated at 25°C for 9 days, those for thermophilic actinomycetes at 50°C for 5 days, and those for bacteria at 35°C for 2 days. Enumeration and speciation was performed at the end of the incubation period.

3. Medical Questionnaire Survey

A questionnaire administered in September 1986 addressed demographic information, work history, current work environment, medical history, and current symptoms.

Participants were asked whether they had experienced any of 18 symptoms from October 1985 to September 1986. Information regarding frequency, duration, seasonality, and onset of the symptoms was also collected.

Participants were categorized as working in the "new" or "old" wing of the building based on the percent of the work day spent in the new or old wings of the building. If a worker spent greater than 75% of the workday in one wing, he/she was classified as working in that wing of the building. Otherwise, the worker was listed as working in "both" wings.

V. EVALUATION CRITERIA

Although no standards exist for airborne microbial contamination, guidelines concerning the significance of different airborne concentrations are beginning to be developed. NIOSH investigators have in the past, through work addressing airborne microbial contamination in office buildings, suggested that a level of viable microorganisms in excess of about 1000 colony forming units per cubic meter of air (CFU/M^3) indicates that the indoor environment may be in need of further investigation and possible improvement.[3] It should be noted that this "action" level does not discriminate between the different classes of microorganisms (i.e., bacteria, fungi, actinomycetes), nor does it represent a fine line between safe and hazardous air concentrations. Essentially this level represents a level at which further environmental evaluation is recommended. This guideline had limited applicability in this particular evaluation because there was clearly a mold/mildew problem in the new wing.

The American Conference of Governmental Industrial Hygienists, Inc. (ACGIH) Committee on Bioaerosols, in their draft protocol for monitoring airborne viable microorganisms in office environments, has proposed a total count of 10,000 CFU/M^3 or more as necessitating remedial action.[1] This document also indicates that remedial action would be necessary if the colony counts of any one species of fungus, bacteria, or thermophilic actinomycetes were in excess of 500 CFU/M^3. Although this level is applied to all three classes of microbes, it was primarily based on research [4] showing that airborne levels of thermophilic actinomycetes in excess of 500 CFU/M^3 were associated with outbreaks of hypersensitivity lung illness. Because most microbial contamination problems in office environments have been associated with moisture incursion problems in HVAC systems, remedial actions have focused on elimination or control of these types of problems.

VI. RESULTS

A. Environmental

1. Initial Survey

The microorganisms identified in the surface wipe samples and in the bulk sample of carpet are presented in Table 1. Fungal growth was evident on all three samples and included several common genera: Aspergillus Cladosporium, Penicillium, and Trichoderma. No thermophilic actinomycetes were identified in any of the samples. Although no culturing was done specifically for bacteria, the lab indicated that bacterial growth was evident in all three samples.

2. Follow-up survey

Viable air sampling results for fungi, thermophilic actinomycetes, and bacteria, as well as total viable microorganism counts are presented in Table 2 and in Figure 1. For each of the three microbial classes, airborne levels (in CFU/M^3) are presented as a sum total of individual species and by their sum total. Only the 4-minute duration samples are reported, as these provided colony counts within an optimum range for accurate counting.

Airborne levels of total viable microorganisms (TVM), representing the sum total count measurements for fungi, actinomycetes, and bacteria, varied somewhat in the new and old wings, where multiple sampling was conducted.

Airborne levels of TVM ranged from 805 to 1587 CFU/M^3 (mean: 1236 CFU/M^3) in the new wing, and from 491 to 1060 CFU/M^3 (mean: 701 CFU/M^3) in the old wing. Single site measurements conducted in the Danzler building and outdoors revealed TVM levels of 138 and 698 CFU/M^3, respectively. It is interesting to note that the TVM level measured outdoors was higher than the levels measured in 2 of 3 sampling sites in the old wing, and much higher than the level measured in the Danzler building. Although none of the sampling locations had TVM levels in excess of 10,000 CFU/M^3, two locations in the new wing, and one location in the old wing, exceeded 1000 CFU/M^3.

Qualitative analysis of the total count data shows that fungi and bacteria comprise the majority of the total microorganisms found in the air samples, with growth of actinomycotal organisms being minimal (Figure 1). The microbial composition of the samples, however, markedly differed by sampling site. Three air samples collected in the new wing contained primarily fungi, which represented about 80% (average) of the TVM's measured in this wing. The major fungal species identified in these air samples were Acremonium, Penicillium, and Pithomyces; the colony count concentrations of each of these species decreased in the same order as presented above in each of the three samples. Acremonium, also known as Cephalosporium, was by far the most abundant fungal species isolated, accounting for an average of about 80% of the total fungal isolates (Figure 2). Acremonium colony count concentrations ranged from 400 to 1328 CFU/M^3 (mean: 875 CFU/M^3); levels at two of the sampling sites in the new wing exceeded the 500 CFU/M^3 level (for individual species) proposed by ACGIH for initiation of remedial actions. No other area had a fungal species concentration in excess of this criterion. It is interesting to note that Acremonium was not the major fungal species identified in the old wing or the Danzler building, although it was the major fungal species identified outdoors. Penicillium, Cladosporium, and Paecilomyces were the major fungal species identified in the old wing and the Danzler building.

Bacteria, represented by 3 common genera (Brevibacterium, Bacillus, and Serratia), comprised a relatively larger proportion of the TVM's isolated in samples collected from the old wing, Danzler building, and outdoors, as compared to the new wing. In fact, in one of the samples collected from the old wing (north hallway), bacteria comprised about 80% of the TVM's. In this particular sample the colony count concentration of Bacillus sp. was 800 CFU/M^3, which exceeded the 500 CFU/M^3 individual species guideline proposed by ACGIH

for initiation of remedial actions. No other sampling site had colony count concentrations of individual bacterial species exceeding this criterion.

As previously indicated, levels of thermophilic actinomycetes (represented by Thermomonospora and Streptomyces species) were low in all of the air samples. Colony count concentrations in all sampled locations did not exceed 80 CFU/M^3 for both species combined.

B. Medical

Fifty-eight of fifty-nine employees completed the questionnaire and are included in this analysis. One full-time employee was on long-term training and was not available for the study. Eleven intermittent employees (adjunct professional staff) were not included in the study because they were not available; their exposure to the NOAA building was minimal.

Twenty-four (41%) of the staff were female and 34 (59%) were male. The average age of all employees was 42. Thirty-one (56%) worked in the new wing and 24 (44%) in the old wing. Three workers reported that they worked in both buildings; they were excluded from all analyses by building since they were too few to be analyzed as a separate category.

A case of occupationally-related respiratory illness was defined as the presence of at least one of eight work-related respiratory symptoms (Tables 3 and 4). Symptoms included in the case definition were chosen because they are commonly reported in allergic illnesses. Cases were also divided into upper and lower respiratory cases as shown in Table 3. Workers meeting the case criteria were then compared to workers reporting none of the symptoms. Comparisons were made by demographic variables, work in the new or old wing, medical history, and work environment.

Eleven (19%) of the staff reported one of the eight work-related respiratory symptoms and are defined as cases. Ten of the cases had upper respiratory symptoms 4 had lower respiratory symptoms. (Three workers had both upper and lower respiratory symptoms).

No difference was found between respiratory cases and non-cases by race, sex, education, hours per day spent in the building, days per month spent working in the field, age, smoking status or by section of the building (Table 5). Cases were more likely to have a history of pneumonia (X^2=2.96 P=.117) or another chest or lung disease (X^2=8.67 P=.034). Cases were more likely to often smell odors (X^2 = 11.02, P=.002).

Four workers were defined as lower respiratory cases (Table 6), reporting at least one of the following work-related symptoms; chest tightness (1), cough (2), wheezy breathing (0), and shortness of breath (1). None of the four lower respiratory cases had more than one symptom. All were in male former smokers who worked in the new wing of the building. All thought that their working environment was too humid, but only half reported often smelling odors. None of these associations were statistically significant.

Ten workers were defined as upper respiratory cases (Table 7), reporting at least one of the following occupationally-related respiratory symptoms; Nose irritation (3), sinus congestion (3), eye irritation (5), sore throat (0), and nasal congestion (2). Eight of ten workers meeting the upper respiratory case definition reported often smelling odors, compared to 10 of the 48 other participants. (X^2=13.54, P<.001)

Workers in the new and old wings of the building did not differ by age, education, hours per day spent in the building, smoking status, or medical history (Tables 8 & 9). However, new wing staff reported fewer years working in the building (2.4 vs 8.6 yrs, t=3.9, P<.001) and more days per month (7.4 vs 2.8, t=2.15, p<.04) working in the field. Proportionately, more men worked in the new wing than in the old wing (71% v 38%, X^2=6.16 p=.013). A larger proportion of workers in the old wing had a family member with a history of allergic illness (asthma, allergy or eczema).

Proportionally more individuals in the new building reported their work environment was too humid (87% vs 58%, X^2=5.9, p=.015). No significant differences were noted in the proportion of workers reporting imbalances in temperature or ventilation, although 30% of workers in the new wing, compared to 48% of workers in the old wing, reported too little air movement.

VII. DISCUSSION

The purpose of this investigation was to document reports of widespread mold growth in the new wing of the NOAA building and to investigate the possibility that microbiological contamination may have been associated with respiratory symptoms.

Despite the use of portable dehumidifiers and other control measures in the new wing, the viable air sampling results show that fungal levels, consisting mostly of Acremonium sp., were in excess of 500 CFU/M^3, the ACGIH proposed level for initiation of remedial actions. Acremonium sp., along with many of the other

fungal species identified, such as Penicillium sp., Pithomyces sp., Cladosporium sp., and Aspergillus sp., are all common environmental fungi which have been identified in other environments where moisture incursion problems were reported in the HVAC system.[4,5]

By the time the initial NIOSH investigation began, interim control measures (use of dehumifiers, surface disinfection) had already been implemented by NMFS. As a result, the airborne microbial levels measured in the NOAA building during our survey were probably well below airborne levels present in the building prior to the use of the dehumidifiers, when mold and mildew growth were widespread. Furthermore, it is also possible that the types of viable microorganisms identified in the building during our investigation, particularily in the new wing, were different from those present at the time the mold/mildew growth was at its worst.

Inhalation of most of the fungi identified, including Acremonium sp., can produce an allergic response in susceptible individuals. In addition to the fungi, other microorganisms such as bacteria, thermophilic actinomycetes, protozoa, and amoebae can also produce an allergic response in susceptible individuals. The development of allergic sensitization is related to the dose and length of exposure to the allergen, as well as individual genetic factors and past exposure history.

The medical survey results do not support the hypothesis that exposure to airborne microbiological organisms in the new wing of the NOAA is associated with respiratory illness.

There are several reasons, however, why such an association could have been missed. First, it is reasonable to assume the airborne fungal levels were higher prior to the fall of 1985. It is possible that some workers' illnesses improved after interim control measures were implemented. The questionnaire only addressed symptoms experienced from October 1985 to September 1986.

Second, because many variables determine sensitivity to airborne allergens, a dose-response relationship between exposure and illness may not be evident if allergy is the cause of the symptoms. Third, more workers in the old wing reported a history of allergic illness in a family member. Because of this difference in family medical background, as a group, workers in the old wing may be more susceptible to developing allergic symptoms.

Fourth, workers in the new wing spent more time away from the building than workers in the old wing. Travel for extended periods during the fall of 1985 and the summer of 1986 would have reduced

exposure to the new wing during a period when air conditioner use and therfore moisture problems are likely to have been most severe. Therefore, accurate estimation of individual exposure to fungi is difficult.

Finally, elevated bacterial levels were found in one sample taken in the old wing, and more workers in the old wing complained that ventilation was inadequate. Thus, the indoor air quality in the old section of the building may not have been optimal.

In conclusion, it is difficult to assess whether the fungal (Acremonium sp.) and bacterial (Bacillus sp.) levels measured in the new and old wings, respectively, pose a health hazard to exposed employees. Airborne microbiological levels in the new wing may have been higher before decontamination and the use of dehumidifiers in the summer of 1985. Development of illness may have required working in the new wing of the NOAA building during the period when mold contamination was most severe.

Little information is currently available which defines the threshold levels at which specific airborne microorganisms are capable of evoking allergic symptoms, or illnesses such as HP or humidifier fever. Further research, especially in the area of dose-related effects of exposure to specific microorganisms, is needed before the health risk of exposure to moderately elevated airborne microbiological levels, as identified in the NOAA building, can be determined.

VIII. RECOMMENDATIONS

These recommendations are essentially the same as those provided to NMFS in our July 1986 letter.

1. The existing insulation on the plumbing system for the new wing fan coil units, including the warm and chilled water pipes and the condenser drain lines, should be replaced to eliminate the moisture incursion problems.

2. All (non-porous) surfaces within the building should be disinfected. Given the fact that mold/mildew growth was evident on interwall surfaces, it may be more effective to fumigate the building with a fungicidal agent.

3. All non-disposable building contents, including books, desks, office equipment, and the ventilation system, should be thoroughly disinfected or cleaned with a vacuum incorporating a high efficiency particulate air (HEPA) filter (which will effectively

contain the microbial spores). Those building contents which cannot be adequately cleaned, such as ceiling tiles, carpet, and portable acoustical partitions, should be discarded.

IX. REFERENCES

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. National Marine Fisheries Service, Pascagoula, Mississippi
2. Department of Commerce, Kansas City, Missouri
3. NIOSH, Atlanta Region
4. OSHA, Region IV

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table 1

Microorganisms Identified from Surface Wipe and Bulk Samples

National Marine Fisheries Service
Pascagoula, Mississippi
HETA 86-372

May 22, 1986

Sample No.	Sample Description	Fungi Identifed
1	Wipe sample, ceiling tile in hallway outside Rm 115	Aspergillus sp. Cladosporium sp.
2	Wipe sample, ceiling tile in Rm 109	Aspergillus sp. Penicillium sp. Trichoderma sp.
3	Bulk sample of carpet, Rm 108	Aspergillus sp. Cladosporium sp. Penicillium sp. Trichloderma sp.

Note: Although no culturing was done specifically for bacteria, the lab indicated that bacterial growth was evident in all three samples. No thermophilic actinomycetes were found.

Table 2

Concentrations of Airborne Fungi, Thermophilic Actinomycetes, and Bacteria in New and Old Wings in NOAA Building, Danzler Building, and Outdoors.

National Marine Fisheries Service
Pascagoula, Mississippi
HETA 86-372

September 16-17, 1986

LOCATION	FUNGI		THERMOPHILIC ACTINOMYCETES		BACTERIA		TOTAL VIABLE MICROORGANISMS[1]
	Total (CFU/M^3)	By species[2] (CFU/M^3)	Total (CFU/M^3)	By species[2] (CFU/M^3)	Total (CFU/M^3)	By Species[2] (CFU/M^3)	(CFU/M^3)
NOAA Bldg., new wing west hallway, outside Rm 115 (NW1)	610	Acrsp (400) Pensp (88) Pitsp (58)	53	Thesp (49) Strsp (4)	142	Bresp (80) Bacsp (62)	805
NOAA Bldg., new wing center hallway, outside Rm 110 (NW2)	1466	Acrsp (1328) Pensp (48) Pitsp (45)	13	Strsp (13)	88	Bacsp (88)	1567
NOAA Bldg., new wing east hallway, outside conference rm. (NW3)	1006	Acrsp (893) Pensp (40) Pitsp (40)	79	Thesp (75) Strsp (4)	230	Bresp (186) Bacsp (44)	1317
NOAA Bldg., old wing west hallway, near freezer (OW1)	310	Pensp (239) Clasp (40) Pitsp (18)	39	Thesp (39)	142	Bresp (80) Bacsp (62)	491
NOAA Bldg., old wing center hallway, outside chem. lab. (OW2)	230	Clasp (70) Pensp (53) Pitsp (40)	35	Thesp (31) Strsp (4)	257	Bresp (177) Bacsp (80)	522
NOAA Bldg., old wing north hallway, 15 ft from outside door (OW3)	150	Clasp (62) Acrsp (31) Pensp (18)	57	Thesp (57)	853	Bacsp (800) Bresp (53)	1060
Danzler building (DANZ)	53	Paesp (26) Acrsp (13) Trisp (9)	58	Thesp (58)	27	Bacsp (18) Bresp (9)	138
Outdoors (OUT)	296	Acrsp (89) Pitsp (84) Aspsp (44)	66	Thesp (66)	336	Bacsp (177) Bresp (133) Sersp (26)	698

1. Sum of total count concentration measurements for 25°C fungi, 35°C bacteria, and 55°C Actinomycetes.
2. The three most abundant fungal species are listed by decreasing order of airborne concentration, with corresponding airborne concentrations in parenthesis.
   CFU/M^3 = colony-forming units per cubic meter of air.

Abbreviations:

Acr = Acremonium sp.
Pen = Penicillium sp.
Clasp = Cladosporium sp.
Paesp = Paecilomyces sp.
Trisp = Trichoderma sp.
p = Aspergillus sp.
p = Thermomonospora sp
p = Streptomyces sp.
Bresp = Brevibacterium sp.
Bacsp = Bacillus sp.
Sersp = Serratia sp.

Table 3

Frequency of Occupationally-related Symptoms
Among the 58 Survey Participants

National Marine Fisheries Service
Pascagoula, Mississippi
HETA 86-372
September 29, 1986

Occupationally-related symptom	Frequency
Fatigue, unusual tiredness	6
Nose irritation	3 *
Chest tightness	1 **
Sinus Congestion	3 *
Eye irritation	5 *
Eye dryness	1
Cough	2 **
Sore throat	0
Vomiting/nausea	1
Headache	2
Dizziness	3
Skin irritation	0
Wheezy Whistling Breathing	0 **
Dry throat	2
Nasal Congestion	2 *
Muscle Aches	1
Shortness of Breath	1 **
Fever or chills	1

* = included in case definition of occupationally-related upper-respiratory illness.

** = included in case definition of occupationally-related lower-respiratory illness.

Table 4

Case Definitions

National Marine Fisheries Service
Pascagoula, Mississippi
HETA 86-372
September 29, 1986

A. Occupationally-related symptom:

1. occurs occasionally or frequently, but not rarely or every day
2. symptom not present more than 6 years
3. symptom begins while at work
4. symptom is not "most noticeable" on weekends

B. Occupationally-related respiratory illness:

1. At least one of eight occupationally-related respiratory symptoms (one or two asterisks, Table 3)

C. Occupationally-related upper-respiratory illness:

1. At least one of four occupationally-related upper-respiratory symptoms (one asterisk, Table 3).

D. Occupationally-related lower-respiratory illness:

1. At least one of four occuaptionally-related lower-respiratory symptoms (two asterisks, Table 3).

Table 5

Respiratory Case Status by Demographic and Exposure Variables

National Marine Fisheries
Pascagoula, Mississippi
HETA 86-372
September 29, 1986

Demographic variables	Case	Non-case	X2	P	Relative(RR) Risk
Sex (Male)	6/11	28/47	0.90	1.000 *	
>42 years age	5/11	22/27	0.01	0.935 *	
College education	11/11	9/47	0.09	0.670 *	
Work in New Wing	7/11	24/44	0.30	0.738 *	
≤ 4 days/month in field	6/11	26/47	0.00	1.000 *	
≥ 6 hours/day in bldg.	11/11	43/47	0.00	1.000 *	
History (Hx) of Medical problems	5/11	25/45	0.36	0.547	
Hx of pneumonia	3/11	4/47	2.96	0.117 *	3.20
Hx of other chest illness	2/11	0/46	8.67	0.034 *	6.11
Hx of allergy	2/11	10/47	0.05	1.000 *	
Hx of Fam. Asthma/Allergy	4/11	20/47	0.14	1.000 *	
Current Smoker	1/11	9/47	0.63	0.668 *	
Ever Smoke	6/11	25/47	0.01	0.935	
Own pets	3/11	18/47	0.47	0.729 *	
Video display Terminal (VDT) > 1 hour/day	4/11	16/47	0.02	1.000	
Temperature OK	7/11	31/47	0.02	1.000 *	
Often smell odors	8/11	10/47	11.02	0.002 *	5.93
Ventilation OK	7/11	28/47	0.06	1.000 *	
Humidity too high	10/11	33/47	1.99	0.257 *	3.49

* Fisher's exact test, 2-tailed p-value

Table 6

Lower Respiratory Case Status by Demographic and Exposure Variables

National Marine Fisheries
Pascagoula, Mississippi
HETA 86-372
September 29, 1986

Demographic variables	Case	Non-case	X2	P	Relative Risk
Sex (Male)	4/4	30/54	3.03	0.134 *	**
>42 years age	3/1	24/30	1.39	0.329 *	**
Work in New Wing	4/4	27/51	3.34	0.123 *	**
≤ 4 days/month in field	1/4	31/54	1.58	0.316 *	
≥ 6 hours/day in bldg.	4/4	50/54	0.32	1.000 *	
Hx of med. problems	2/4	28/52	0.02	1.000 *	
Hx of Fam. Asthma/Allergy	1/4	23/54	0.99	0.370 *	
Current Smoker	0/4	10/54	0.90	1.000 *	
Ever smoke	4/4	27/54	3.74	0.116 *	**
VDT use	2/4	18/54	0.46	0.602 *	
Temperature OK	4/4	34/54	2.26	0.287 *	
Often smell odors	2/4	16/54	0.72	0.580 *	
Ventilation OK	3/4	32/54	0.39	1.000 *	
Humidity too high	4/4	39/54	1.49	0.564 *	

* Fisher's exact test, 2-tailed p-value
** Relative risk is undefined (division by zero).

Table 7

Upper Respiratory Case Status by Demographic and Exposure Variables

National Marine Fisheries
Pascagoula, Mississippi
HETA 86-372
September 29, 1986

Demographic variables	Case	Non-case	X2	P	Relative Risk
Sex (Male)	5/10	29/48	0.37	0.543	
>42 years (Mean age)	4/10	23/48	0.21	0.737*	
Work in New Wing	6/10	25/48	0.07	1.000	
≤ 4 days/month in field	5/10	27/48	0.131	0.740*	
≥ 6 hours/day in bldg.	10/10	44/48	0.895	1.000*	
Hx of Med. problems	4/10	26/46	0.90	0.487 *	
Hx of pneumonia	3/10	4/48	3.66	0.091 *	
Hx of other chest illness	2/10	0/47	9.74	0.028 *	
Hx of Fam. Asthma/Allergy	4/10	20/48	0.06	1.000 *	
Ever smoke	5/10	26/48	0.06	1.000 *	
Current Smoker	1/10	9/48	0.44	0.675*	
VDT use	4/10	16/48	0.163	0.687	
Temperature OK	6/10	32/48	0.16	0.724	
Often smell odors	8/10	10/48	13.54	0.001 *	8.89
Ventilation OK	6/10	29/48	0.00	1.000 *	
Humidity too high	9/10	34/48	1.59	0.400 *	3.14

* Fisher's exact test, 2-tailed p-value

Table 8

Demographic and Exposure Variables by
Section of the Building

National Marine Fisheries
Pascagoula, Mississippi
HETA 86-372
September 29, 1986

	New Wing		Old Wing		t value	P value
Participants	31		24			
Average (Avg) age	44	(1.7)*	41	(2.7)*	0.7	0.5
Avg Yrs of School	16	(0.3)	15	(0.5)	1.3	0.18
Hours per Day in Bldg	8.3	(0.2)	7.7	(0.3)	1.4	0.17
Years in Bldg	2.4	(0.2)	8.6	(1.6)	3.9	<.001
Days Away per Month	7.4	(2.0)	2.8	(0.9)	2.2	<.04

* = S.E.M.

Table 9

Demographic and Exposure Variables by
Section of the Building

National Marine Fisheries
Pascagoula, Mississippi
HETA 86-372
September 29, 1986

VARIABLE	NEW	OLD	X^2	p value
Race (White)	27/31	20/24	0.15	0.717
Sex (Male)	22/31	9/24	6.16	0.013
>42 years age	16/31	11/24	0.18	0.670
School (HS/College)	2/28	6/18	3.55	0.060
Medical Problems	16/31	13/22	0.29	0.590
Hx Fam Asthma/Allergy	8/31	15/24	7.49	0.006
Current Smoker	6/31	2/24	1.32	0.250
Copying machine use	0/31	3/21	4.77	0.060 *
Carbonless copy paper	6/31	6/22	0.46	0.524 *
VDT use	11/31	8/24	0.03	0.868 *
Carpeting in office	30/31	20/24	2.96	0.156 *
Plants in office	14/31	7/24	1.47	0.226
Temp-Ok	22/31	13/24	1.65	0.199
Humid too high	27/31	14/24	5.9	0.015
Ventilation OK	21/31	12/24	1.77	0.183
Often smell odors	10/31	7/24	0.06	0.805

* Fisher's exact test, 2-tailed p-value

Abbreviations for Figures 1 and 2

NW1 = New Wing, west hallway, outside Rm 115
NW2 = New Wing, center hallway, outside Rm 110
NW3 = New Wing, east hallway, outside Conf. Rm
OW1 = Old Wing, west hallway, near freezer
OW2 = Old Wing, center hallway, outside chem. lab.
OW3 = Old Wing, north hallway, 15 ft. from outside door
DANZ = Danzler building
OUT = Outdoors

Acrsp = Acremonium species
Pensp = Penicillium species
Pitsp = Pithomyces species
Clasp = Cladosporium species
Paesp = Paecilomyces species
Trisp = Trichoderma species
Aspsp = Aspergillus species

CFU = Colony-Forming Units

TOTAL VIABLE MICROORGANISMS

SEPTEMBER 16–17,1986

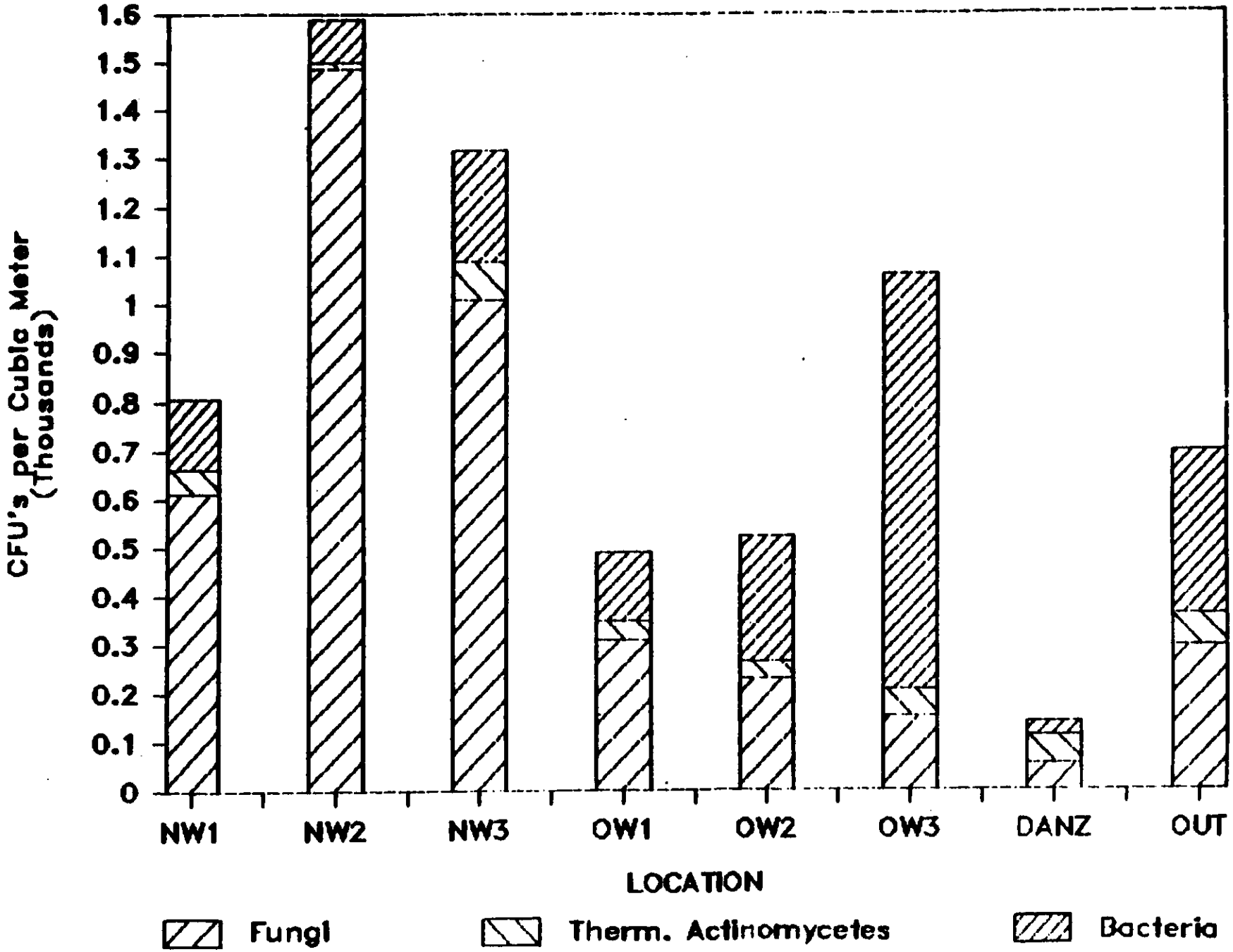

FIGURE 1

AIRBORNE FUNG CONCENTRATIONS

SEPTEMBER 16-17, 1986

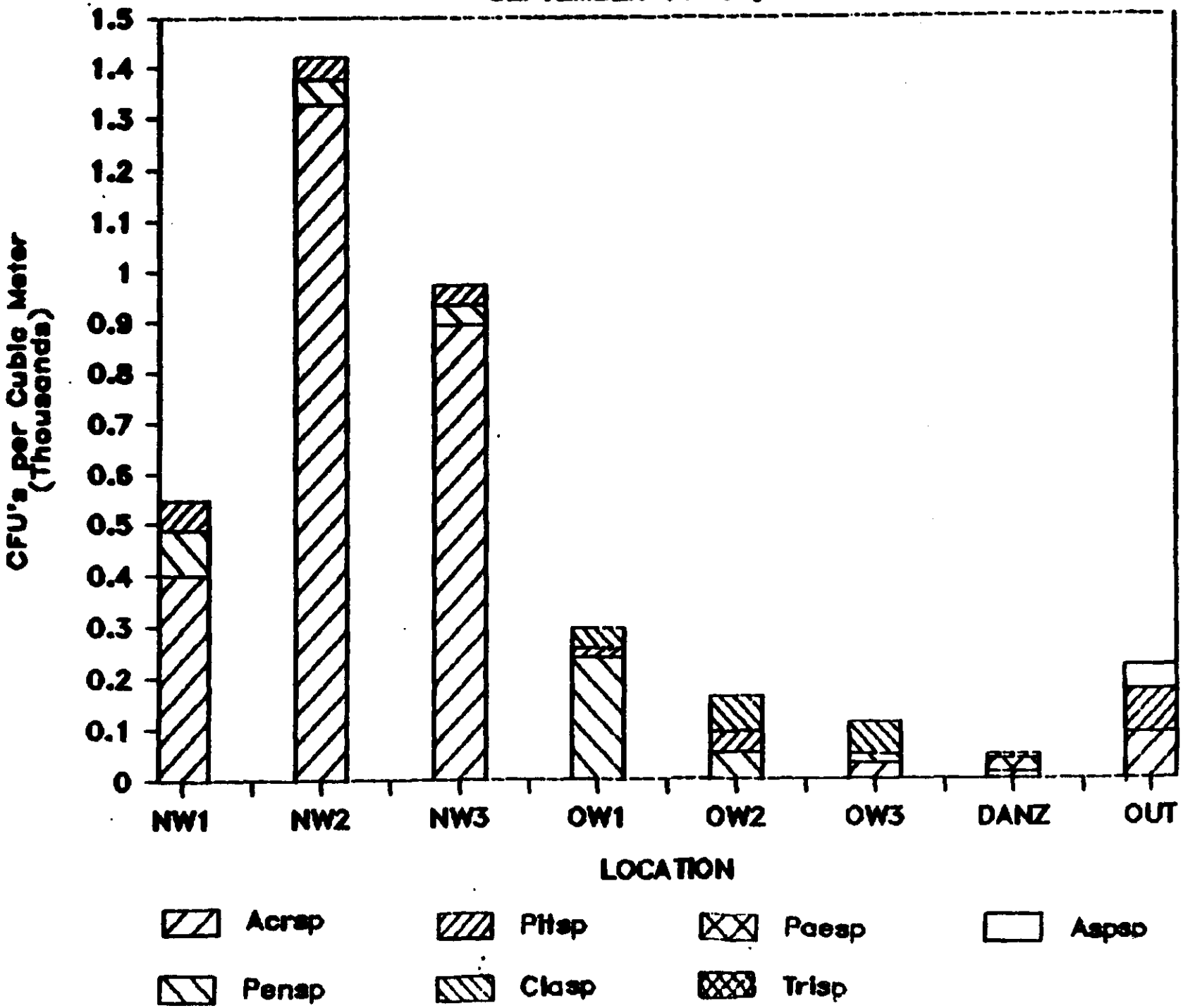

FIGURE 2