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TSUNAMI HAZARD AND COMMUNITY PREPAREDNESS IN ALASKA

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CONTENTS

Abstract..... 1
Introduction..... 1
Origin of Study..... 2
Preliminary Work..... 2
Questionnaire..... 3
Regional Division..... 4
Timing of Visits..... 4
Pre-Visit Contacts..... 4
Logging Camps..... 5
Community Visitations..... 5
Preparedness Rating..... 6
Communications..... 10
Preparedness Assessment..... 12
Briefing Content..... 13
Conclusion..... 14
Acknowledgements..... 15
Appendix A, Letter and Questionnaire.. 16
Appendix B, Community Assessments..... 20

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ABSTRACT. The tsunami hazard for the Alaskan coastline, the effectiveness of the Alaska Tsunami Warning System, and individual community preparedness was evaluated during the period 1970-1978. Many deficiencies, especially in communications, were discovered and corrective action taken where possible. The technique of the study is presented with recommendations for future studies. A nine-factor preparedness rating system was devised to objectively assess a community's ability to respond to a tsunami emergency. A minimum preparedness level was estimated and 12 of 38 communities were below this level. Eighty percent of the communities assessed as very well prepared had a population over 1000. The study indicates many smaller communities will probably need outside help if they are to achieve minimal preparedness. All information gathered was shared with the Alaska Division of Emergency Sevices, as was a plan to display tsunami notification cards (placards) around coastal communities and publish "safe area" maps in local phone books.

INTRODUCTION

Since its dedication in 1967, the Alaska Tsunami Warning Center (ATWC) has worked steadily to improve its performance and reliability. After a couple of years of operation, it was realized not much was known about the effectiveness of the tsunami warning system (TWS) at the community level. In discussions with the Alaska Division of Emergency Services (ADES), many areas of weakness were found, especially in communications. ADES was concerned and was working within resources to improve the situation.

The ATWC also became involved in evaluation of the communications fan-out and estimating tsunami hazard. A limited

study, primarily demographic, was made in 1969-1970. A much more extensive study was begun in 1976 and continues to the present. The current study includes evaluation of the tsunami hazard, visits to various coastal communities, and a systematic education program.

ORIGIN OF STUDY

During 1969-1970 an effort was made by the ATWC to determine the number of coastal communities in Alaska that might be affected by a tsunami. No state or federal agency was found to have a complete list of coastal communities. The closest that could be found was the Alaska District, Corps of Engineers' Flood Hazard data, listing 77 communities and suburbs on the Pacific Coast.

An intensive study was initiated by the ATWC and over 20 more coastal communities were discovered; some already listed were found to no longer be in existence. Data from the 1970 Census were timely and helpful. By late 1970, 103 communities were identified. This listing was given to ADES and, with tsunami hazard comments, to the Corps of Engineers. Nothing more was done with the project until 1976.

The Tsunami Warning System was taken over by the National Weather Service (NWS) in September 1973 to consolidate the federal government's natural disaster warning systems. In 1976 the NWS headquarters began a program to look more closely at its various warning "products." They wanted to see how effective the warning system was and to identify possible weaknesses in the overall system, from the Weather Service to the endangered individual.

In the NWS Alaska Region, the ATWC was instructed to begin an evaluation of its tsunami watch and warning system, including visits to communities.

PRELIMINARY WORK

Before any visits could be made, much preparation in the office was necessary. The community listing from the 1970 study had to be brought up-to-date. Only communities with a population of over 25 were on the 1970 list and a few had dropped below that number. Some suburbs had become so closely tied to their larger neighbor that they were deleted but others were found to be independent so were added. The 1976 listing was tentatively revised to 89 communities.

The NWS <u>Communication Plan for Tsunami Warning System</u> and the <u>Alaska Tsunami Warning Plan</u> of ADES were both searched to determine how many communities were listed as recepients for a warning. A listing was prepared in April 1976 showing how communities received their warning. The list revealed 41 of the 89 communities were not shown on either plan. From personal knowledge, many of the 41 were known to receive a direct warning.

Of the 48 that were listed, several did not have 24-hour communications. This information was shared with ADES and a close working relationship was established to improve this listing.

By October 1976, the number not receiving a direct warning message or method unknown was cut nearly in half, to 22. The ADES prepared a revised plan which added 19 communities and updated other information. Much of this information was gained from a questionnaire sent by ATWC in August 1976.

QUESTIONNAIRE

As might be expected, very little was know about most of the smaller communities and many would not be visited. Therefore a questionnaire was prepared to be sent before any visits were planned. Another problem was that many of the smaller communities had only a loosely organized municipal government, so to whom could the questionnaire be sent? As nearly all these towns had a school, and teachers are used to filling out forms, the first questionnaires were addressed to the principal or principal teacher. The listing of schools was obtained from the Alaska Department of Education. Many of the teachers would be new to their area so they were encouraged to seek "knowledgeable advice" in their community in completing the answers.

The questionnaire was kept brief and addressed three topics. First, as the 1970 census information was now obsolete, a population estimate was requested. Most Alaskan coastal communities have large seasonal fluctuations so that variability was included as a consideration. Second, the majority of the questions concerned communications capabilities. The third topic was a very general indication of the tsunami hazard. (See Appendix A for a sample letter and questionnaires).

In late August 1976, 44 questionnaires were sent to smaller communities. By the end of September, 33 were returned (75%). Finally, 35 were received for an 80% response.

The ADES hosted a civil defense directors' seminar in September 1976. The community preparedness specialist at the ATWC was invited to give an extensive briefing on earthquakes, tsunamis and the warning system. The directors from coastal towns agreed to help with a second questionnaire. In addition to responding to questions about their own town, they would be given questionnaires for small surrounding communities that had not responded to the first mailing or had not been sent one.

To complete the coverage with the second mailing, the Weather Service Offices (WSO) at Cold Bay and Homer were asked to help with communities in their areas. In December 1976, 22 letters were sent covering a total of 71 communities. Eventually, 16 replies were received including responses for 47 communities. Logging camps were identified with help from the Alaska Loggers Association and were sent questionnaires in early

1977.

The total questionnaire response was 80 out of 103 communities or 78%. Communities with communication weaknesses and potentially serious tsunami hazards were identified. As visits were planned, the questionnaire response helped identify important fan-out centers (Ketchikan, Juneau, Sitka, Kodiak, Cold Bay, and Kenai), all of which were visited; possible fan-out centers that might be added; local problems that might easily be helped; and communities most receptive to visits.

REGIONAL DIVISION

For logistics convenience the state was divided into four regions: Southeastern Alaska plus Yakutat and Cordova; the Kenai Peninsula and Prince William Sound; Kodiak Island; and the Alaska Peninsula and Aleutian Islands. All trips were coordinated with the regional supervisor of ADES. The person making the visits would be representing the NWS and not just the Tsunami Warning System, so the Operations Division of the Alaska Region gave a briefing on other Weather Service watch and warnings as appropriate. A detailed briefing on the NOAA Weather radio was timely as it was just going into service in the various areas to be visited.

TIMING OF VISITS

The success of the visits varied with the interest and support of the host community and if it was at a "good time". Timing was obviously difficult as an opportune time in one place may be a bad time at another. Work in Alaska is very seasonal, not just because of weather but also due to fishing seasons, timber harvest periods, hunting and many other factors. In many small towns the mayor or fire chief was also a commercial fisherman. Many still depend upon subsistance hunting. In the winter, school is in session but work is at a null point, so those in the timber and fisheries industry often take their vacation. Chances of being "weathered in" are good during the winter. Generally the late spring or early fall was found best for coastal Alaska.

PRE-VISIT CONTACTS

Most trips were made by contacting a regional public safety official: ADES, borough, State Troopers, or WSO. Regional officials, knowledgeable about the area, can be most helpful in advising whom to contact and the best time to visit. Often, where others had made the schedules or appointments, the communities were not well prepared for the visit. Only in Southeastern Alaska were most places contacted directly by letter from ATWC with follow-up correspondence completing details.

If the local director was not well briefed on the purpose of the visit, he could not arrange meetings or put out pre-visit publicity. Some were even skeptical at first, not knowing the

real purpose of the visit. Most communities sincerely appreciated the information and help given. Although direct contact was much more time-consuming, the results were worth the extra effort.

Many of the larger communities had been visited by ADES to discuss all natural disaster and civil defense emergencies including tsunamis and earthquakes. Where these visits had been recent, the communities were found to be much better prepared. Emphasis could then be made on the details of earthquake and tsunami preparedness. Specific questions by local officials often led to changes in their procedures. Changes made and other information were shared with the ADES Regional Supervisor in a post-visit debriefing.

LOGGING CAMPS

Literature on the Alaska Loggers Association received in 1976 from the U.S. Forest Service caused a rethinking of a decision made in 1970. In the 1970 study to identify all Alakan coastal communities over 25 population, some logging camps were found in Southeastern Alaska over this number. The ADES recommended not including any camps at that time because most were mobile, seasonal, with no municipal government, and had marginal communications. The ALA literature indicated some camps were quite large and remained at the same location for a few years. Information received from the State of Alaska Board of Education also indicated some camps were "floating"; that is, on barges and rafts at the beach, or mobile home and skid-mounted buildings pulled up on the beach just above the tide.

For example, Coffman Cove camp on Prince of Wales Island had a population of approximately 200 for 10 or 11 months per year. Logging was suspended during the midwinter due to deep snow. Most loggers and their families left the camps at this time for vacation. Even the school term was specially arranged for this schedule with half the vacation in midwinter, the other half in midsummer.

Communications with most camps is by HF-SSB or VHF radio. The ALA maintains a 16 hour-per-day radio watch; the local charter airlines also have good radio contact during most daylight hours. At the Loggers' Conference, the NOAA Weather Radio (NWR) was strongly emphasized as a reliable 24-hour warning device for those camps able to receive the signal. (As most travel is by sea or air in Southeast, the weather is critical to their daily activities and the NWR would be important day by day for routine travel and storm advisories.) Several logging camps have been added to the ATWC list.

COMMUNITY VISITATIONS

The invitation to give a presentatin at the Alaska Loggers' Association Convention in Juneau in March 1977 set the timing for the first trip. A total of 9 communities were visited plus the

suburbs of Juneau, Ketchikan and Petersburg. Letters were written to officials requesting they arrange briefings with all those in the community that would be actively involved in a tsunami or earthquake emergency. Presentations to civic groups, school classes, and radio/TV were also made. Between meetings, photographs of the local coastline were taken and local maps were used to note the tsunami hazard in the community.

The trip to the Alaska Peninsula and eastern Aleutians was made in the early fall of 1977. Major communities of Sand Point, Cold Bay and Dutch Harbor were visited. The smaller communities of King Cove, Perryville and Chignik were visited by small charter aircraft. This was an area where little was known and much accomplished. ADES had never been to this area for briefing or training so all work done was most important. Except for Cold Bay, none of the communities had written tsunami (or any other natural disaster) plans. Communication possibilities were discovered that had not previously been utilized. ALASCOM satellite TV, Community Health Aid phones, and a Dillingham radio station could all be used in this region and were not part of the existing plans.

On the Alaska Peninsula there is no logging; fishing is a primary industry. A visit had been planned to False Pass. The entire livelihood of the community centers around fishing and the local cannery. The visit had to be cancelled as it fell between salmon and crab season, and the manager and all his assistants were gone. In many small communities such as King Cove the local cannery is not just the place of employment for much of the the population. The cannery usually provides electric power, maintains the fire equipment, provides the water system, and so forth. For this reason it is essential to involve the cannery manager in discussions along with the town mayor, president of the Village Council, or head of the local Native Association.

The Kenai Peninsula communities were almost entirely accessible by road. The Kenai Borough has a full time Civil Defense Director who was well-briefed on the operatin of tsunami warning system. Just about every community was visited for inspection purposes and Seward, Nikiski, Kenai, Homer, and Seldovia had combinations of public presentations, radio interviews, meetings with officials, and plan reviews. Again as an example of logistics problems, English Bay and Port Graham could not be visited. All flights on the day of the visit were tied up for the funeral of a local pilot.

The visitation to Kodiak Island also had one community missed due to logistics. A charter flight to Port Lions was to be followed by a fishing boat ride to Ouzinkie and then the small mail plane flight back to Kodiak City. After arriving at Port Lions it was found the only 2 boats left in town were too low on fuel to make the trip and no fuel was available locally at the time. This pointed out another interesting situation in the case of a natural disaster. Although the town has fuel storage facilities, the tankers come only twice a year--when the power

plant orders diesel fuel. At that time, the local residents can order a 6 month gasoline supply for autos and boats, cash in advance. Usually the last month or two before delivery, supplies get very short.

The city of Kodiak is quite well organized and, from their 1964 experience, probably better so than many communities. The potential tsunami hazard here is quite high with several canneries, the city power plant, much of the commercial development, many residents, 2 fuel docks and storage near the beach.

PREPAREDNESS RATING

To assess preparedness, a rating system was devised based on 9 factors in a community's ability to respond to a tsunami warning and subsequent inundation. An attempt was made to keep the factors as objective as possible (figure 1). The following comments refer to the annotated tsunami preparedness rating factors listing. Communications will be addressed separately because of its importance.

A written tsunami action plan is important for at lease two reasons: (1) The effort to prepare a plan causes the local official to think out what needs to be done in an emergency. (2) It gives the dispatcher on duty, or others not trained or experienced in tsunami procedures, a quick reference set of instructions. The "who-to-call" list with numbers must be kept current and, because the community changes, the plan needs frequent reivew.

A siren system is the best means to quickly warn people in an urban area. When a tsunami could srike within minutes, going from door-to-door or using PA-equipped vehicles is not adequate. The "placard" referred to on the factor chart is a small but highly visible card, usually adhesive-backed. It briefly describes what the siren signal for evacuation is and where to go. Not all coastal communities use the same signal or method and many tourists visit these towns. Figure 2 is a sample of Homer's placard. To insure the siren is operational, verify coverage as the town expands and remind residents; the siren system should be tested regularly.

FACTORS	RATING
COMMUNICATIONS WP means Warning Point receiving message directly from ATWC via NAWAS, telephone or radio.	6: NAWAS or direct phone, teletype backup 5: NAWAS or direct phone, no backup 4: Telephone from WP, reliable backup 3: Telephone from WP, no backup 2: Telephone from WP, not available 24-hours 1: Indirect (marine radio, TV, NOAA WX Radio) 0: None
WRITTEN TSUNAMI ACTION PLAN	2: Yes, detailed and trained CD director 1: Not detailed and specific or not current 0: None
SIREN, WHISTLE, CB If placards used add 1 point, if siren not tested regularly subtract 1 point.	3: Good coverage, esp. in vulnerable areas 2: Partial coverage, cars with PA or home CB 1: Not used or none, partial CB coverage 0: None
POLICE DEPARTMENT If Troopers, count only if usually "in town"	3: Full-time, dispatched 2: Most hours covered, 24-hour dispatch 1: Most hours covered, no 24-hour dispatch 0: One officer only or none
FIRE DEPARTMENT Fire phone: dedicated system to most members.	3: Full-time, dispatched 2: Trained volunteers, dispatch or fire phone 1: Volunteers, no dispatch or fire phone 0: Unorganized or none
SAFE AREAS DEFINED If placards used add 1 point	3: Yes, easily accessable and adequate 2: Yes, less easy access or less adequate 1: Safe areas, poor access or poor accom.
EMERGENCY EQUIP. AND SUPPLIES Heavy equip., generators, medical, food, tents, etc.	3: Most available in a safe location 2: Some supplies available 1: Little available, or unsafe location
IMPORTANT SERVICES VULNERABLE Fire, water, hospital, power, dispatch, ambulance, fuel, earth station antenna, etc.	3: Most available in a safe location 2: Half available or in a safe location 1: Few abailable or safe 0: All vulnerable or not available
STRUCTURES VULNERABLE If cannery critical to town, lower rating 1 point, unless score already equals 0.	4: None to 10% ± vulnerable 3: 25% ± 2: 50% ± 1: 75% ± 0: All

Figure 1. Annotated tsunami preparedness rating factors.

TSUNAMI-- (Su-nammee)

If you hear a continuous, uninterrupted blast on the sirens, this means Homer has received warning of a posisible TSUNAMI (seismic sea wave). All persons in low-lying areas should immediately move to higher ground.

The area in the vicinity of the Post Office, City Hall, the High School, or above Pioneer Avenue or East Road is high enough to provide safety. Go There at Once.

If you feel an Earthquake that lasts 30 seconds or longer, it might mean a TSUNAMI has been generated nearby and will hit Homer before warning can be given. Move to a safe area at once.

Figure 2. City of Homer's Tsunami Placard.

To be most useful, every household should have a placard on the wall or on the phone book. They can be placed in every motel room, harbormaster's office, phonebooth, etc. The ATWC strongly recommends the placard and in the summer of 1977 urged the ADES to try to get as many communities as possible to use them. Every place visited was given samples and encouraged to adopt them. A map showing "safe areas" with instructions, as done in Hawaii, should be in every coastal town's phone book in Alaska.

CB radios are included because many small towns, especially ones with no home telephones, have CB's in practically every house. They are usually left on 24 hours a day and most everybody in town is on the same channel. In these towns the CB then becomes an important full-time method to alert most homes at once.

Police and fire department personnel, as trained public safety officers, will be greatly needed during the emergency. A 24-hour dispatch will insure timely notification locally and a reliable place to call with the warning message. Many small villages have no trained volunteer fireman and only a part-time police office.

Safe evacuation facilities vary greatly. Just about every town has someplace to go above the hazard zone, even if only "through the woods and up the hillside"; although not comfortable, it would save lives. However, if a long wait is necessary before the wave is expected, or during inclement weather, some may not go or might return before the danger is over. For those reasons the adequacy and accessibility are rated.

The availability of emergency equipment and supplies in safe

locations would be most important after a serious tsunami struck. Yet if emergency medical supplies were lost and heavy equipment was not available for repair or rescue, additional lives could be lost or injury result. Because of the proven resourcefulness of Alaskans in coping with difficult situations, there is no "0" point in the category.

In the first 7 categories, improvement in the rating can be made by most communities. In fact, the visitations themselves improved the rating of some towns by causing the adoption of placards, writing or updating a tsunami plan and improving communications. The last two categories are not so easily improved. They deal with important services and facilities already located in the tsunami hazard zone.

The tsunami hazard zone has been very roughly estimated for tsunamis generated far from the community in question. They are divided into high, moderate or low, representing maximum wave heights of 50, 35 and 20 feet respectively. This rating is shown in Appendix B. The hazard from a "local tsunami", or one generated nearby, is much greater but even harder to predict. A locally generated wave is assumed to have a possible height of 100 feet although higher waves have occurred. All communities are assumed to have a local tsunami hazard but the vulnerability was determined from the distant tsunami, wave height estimate.

One of the benefits of the visitation was at Hydaburg. Hydaburg was planning a new firehall at the time of the visit; one site was within the hazard zone and another well above. All other factors had made the choice a toss-up but the tsunami hazard had not been considered.

Some communities are particularly vulnerable, such as Old Harbor, rebuilt on the same site where the 1964 tsunami completely destroyed almost every building in the town. Others, such as Kenai, set on a high bluff, are comparatively safe. Since there is little likelihood in improving the rating in the last two categories, should they be in a preparedness assessment? If a town has many residents in a tsunami-vulnerable zone, it will greatly complicate evacuation and, if essential emergency service facilities are lost when most needed, it will certainly have an effect upon the ability of a community to repond to an emergency.

COMMUNICATIONS

Communications are critical to the operation of the tsunami warning system. The ATWC can locate an earthquake, determine its magnitude, and decide whether a warning should be issued, within 15 minutes. But if the information cannot be quickly distributed to endangered communities it is of no value. Figure 3 shows the communication capability of the ATWC. The NWS issues and periodically updates its Communications Plan for the Tsunami Warning System and the state of Alaska has its own detailed fan-out in the ADES Natural Disaster Plan.

The state of Alaska will soon insure that every town in Alaska over 25 population is accessible by telephone; most coastal communities now have this service. The Aleutian village of Atka is particularly isolated. Prior to the installation of the satellite earth station and telephone, they received warning messages air-dropped by a Navy plane from Adak (180 miles away), weather permitting! Yet in many coastal towns such as English Bay, Old Harbor and Port Graham, the phones are in a community center building that is usually open only 8 hours a day. Besides the community phone, most villages have a Community Health Aid phone.

Where the village clinic is also in the community building, such as in Old Harbor, it still can be called only a few hours a day. At Perryville the clinic is in the aid's home and there is usually someone in the house. The villages have direct 24-hour access to the Alaska Native Medical Center (ANMC) in Anchorage. ATWC has suggested to ADES that for certain communities such as Perryville the ANMC should be included in the fan-out. Most communities with satellite earth stations also receive live television; the state is adding more. The programming can be interrupted for emergency announcements. Broadcasting runs 12-16 hours per day and in many village homes the TV sets are on the entire time.

One additional means to get a hard copy (teletype) message

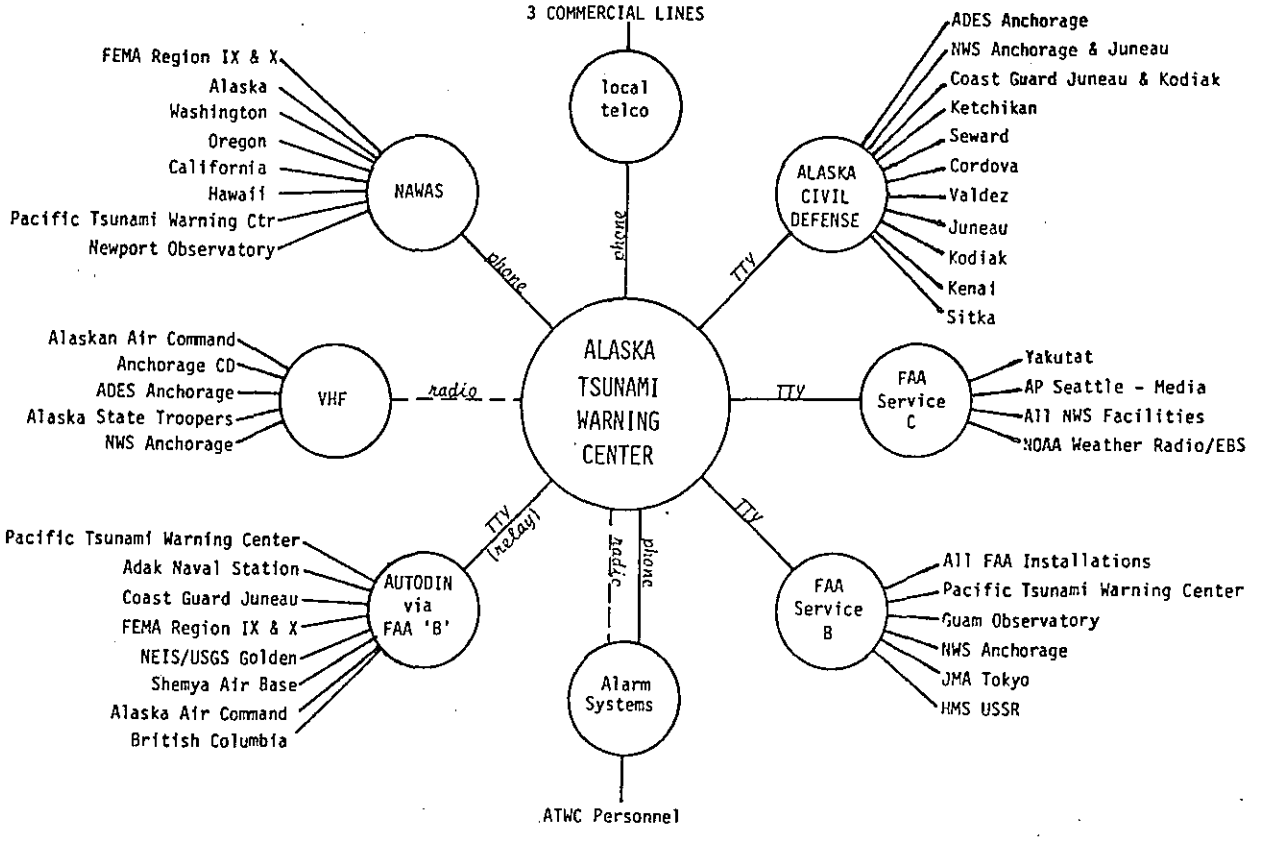

Figure 3. Alaska Tsunami Warning Center communication system.

to many larger coastal communities is the state's Judical Services Teletype (JST) system. The hard copy has certain advantages over voice-given messges, the most important being less chance of misunderstanding and less chance of mistakes when relaying information to others. The main disadvantages are somewhat slower dissemination time and no immediate acknowledgement.

Currently, the quickest method to reach 9 larger towns isthe NAWAS phone system. Five of these cities have important fan-out responsibilites, yet none get a hard copy. Three of the five have direct access to the JST. The JST goes to most coastal towns with more than a one officer-police department as well as several other agencies. A terminal on this circuit should be considered for the ATWC. As teletype message preparation is now automated, the time required to get a message out is only a few minutes.

PREPAREDNESS ASSESSMENT

When a community was visited, a 2-page information sheet was prepared with information from local officials and personal observation. The Tsunami Preparedness Assessment is made from those data (Appendix B). The assessment gives a numerical indication of a community's preparedness but does not necessarily say how well they will respond in an actual emergency. A total below 16 does show communities with weak or no civil defense organization and/or a high tsunami vulnerability.

To evaluate preparedness from the assessment ratings, three factors in particular are most important. First, the "Tsunami Hazard" tells the seriousness of the tsunami threat to the town. If the threat is low, then a lesser degree of preparedness may be acceptable. Second, "Communications" may be the most critical. Any community with a 2 or less in this factor may not receive a warning. If the warning message is not received, a plan, a siren system, trained officials, or safe areas are all of little value. Yet, poor communications may not be so serious if little or none of the town is in the tsunami inundation zone. Therefore, this third factor must be considered. A rating of 4 under "Structures Vulnerable" would generally indicate few people would be in the danger zone.

Some examples taken from the preparedness assessment in Appendix B will illustrate these points. Both Cohoe and Kachemak have a marginal total score of 16 and a moderate tsunami hazard with marginal communications. Yet both communities have few or no structures in the inundation zone. Unalaska, also with a total score of 16, has a moderate tsunami hazard and marginal communications. But the structural vulnerability is high. Therefore 16 for Cohoe and Kachemak may be acceptable whereas Unalaska may need improved preparedness in the areas of communication, planning and a siren system, for example. Four communities with a high tsunami hazard have a total score of less than 10 and have minimal or marginal communications. Nikolski, Old Harbor,

Chignik and Perryville are also deficient in safe evacuation areas.

The rating total was plotted against population. As expected, the better organization of larger cities is apparent. The relationship between score and population is not so clear below a population of 700 on the linear plot (figure 4a). Ninety percent of the communities with a total rating of 17 or less have a population of less than 400. More than 80 percent of the communities with a total rating over 20 have a population over 1000. The logarithmic plot in figure 4b shows preparedness increases steadily as population increases exponentially. This would indicate many smaller communities will probably need outside help if they are to achieve some minimum level of preparedness.

BRIEFING CONTENT

The briefings given in each community are done with either slides or a notebook with 8 X 10 photos and charts. Slides are

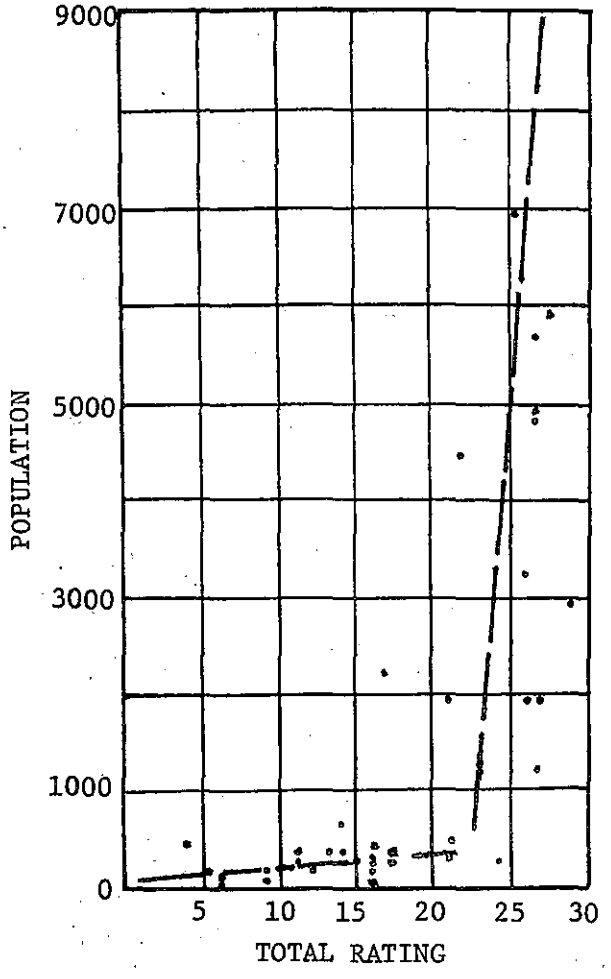

Figure 4a. Linear plot of population vs. total preparedness rating. The 2 dashed lines are linear least squares approximations of the relationship.

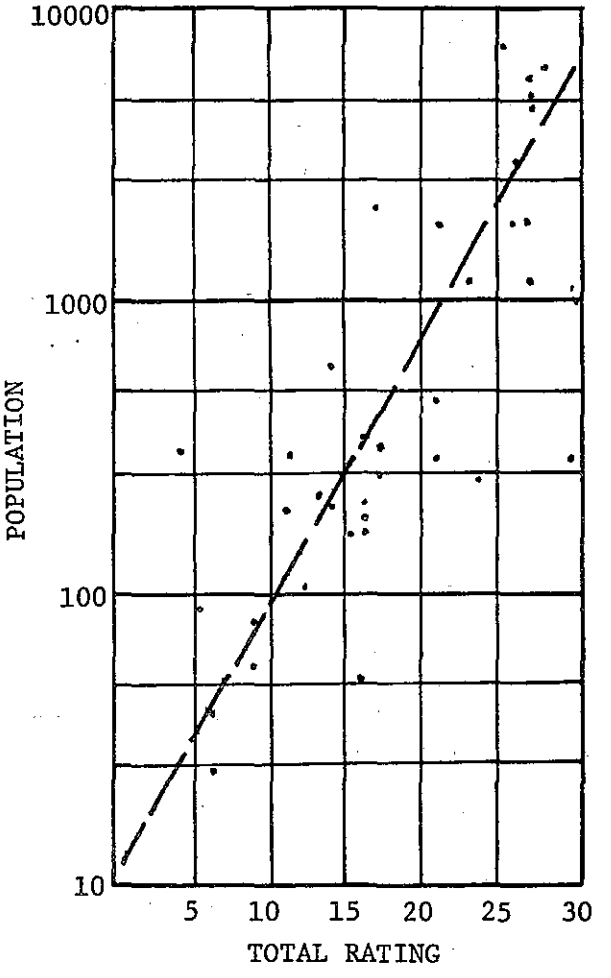

Figure 4b. Logarithmic plot of population vs. total preparedness rating. The dashed line is a good least squares approximation of the relationship.

generally used in school classes and with larger groups. In small villages, or when only a few people are present, the notebook is used.

The presentation shows:

1) The warning center at Palmer
2) How earthquakes are recorded and located
3) The communications system
4) The nature of earthquakes and tsunamis
5) Personal safety rules during earthquakes and tsunamis

Special emphasis on the local area is given throughout the presentation. A question and answer period follows all talks; interest has always been very high. The Tsunami Watch and Warning brochure and When an Earthquake Strikes, both by NOAA, are given out. A few copies of an out-dated brochure on the Alaska Regional System remain and they are also given out.

These brochures have vital details the public should be aware of and are brief and attractive. They should be periodically updated, however, to be of maximum benefit and not be misleading. The brochures were included in letters sent out with questionnaires. Visitors to the center in Palmer receive them; they are being distributed in Alaska by ADES.

Another important education device is the NOAA film "Tsunami." Extremely well done, it could be used in many small communities to reach practically the whole population, or in schools and with other groups in larger communities. Unfortunately, having been made just after the 1964 tsunami, it includes nothing about the Alaska system. There are critical differences in the operation of the Pacific and Alaska Centers; some details are in error. One important aspect of the film is the emphasis on evacuation before a tsunami strikes. The film continues to be in demand so the ATWC and others still distribute it.

CONCLUSION

The Tsunami Hazard Study in Alaska has primarily identified areas of weakness in the overall system. Yet it has also made great strides in understanding the problems of the local public safety official and the community. The largest gains in the program are from improved communications and better procedures for alerting the public when a warning is issued.

As communities are given an estimate of the tsunami hazard to their coastline, they can plan more wisely for future development and have a realistic evacuation plan. Several communities without sirens, written plans or placards may have them as a result of the first visits. Revised brochures and an updated "Tsunami" film would greatly expand the educational process and provide for follow-ups in communities between visits.

The hazard study in Alaska will continue with additional data-gathering efforts, communications system work and plans to automate data storage and retrival. Return visits to major communities should be approximately every two years with different small towns visited each time. This schedule will help insure that key fan-out centers are current in their procedures and eventually allow visits to most coastal communities in Alaska.

ACKNOWLEDGEMENTS

I wish to thank Mr. Robert A. Eppley and Mr. Richard L. Crisci for their helpful editorial comments. Edward S. E. Newbury, Director, and the staff of the Alaska Division of Emergency Services were most cooperative and helpful in the study as were the various city managers, police chiefs, fire chiefs, and many other local officials I met during community visitations. I also wish to thank Dianna Alcantra who typed the drafts and Lisa Vasconi who typed the final copy.

APPENDIX A. Cover letter for questionaire

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE
Alaska Tsunami Warning System
Palmer Seismological Observatory
Box Y, Palmer, Alaska 99645

27 August, 1976

Principal Teacher or Principal

The Palmer Seismological Observatory is the headquarters for the Alaska Tsunami Warning System. As you probably know, tsunami is the technical name for what most people call a tidal wave.

We are trying to assess the tsunami hazard for coastal communities in Alaska. We would appreciate your help in this assessment. The questions I need answered at this time are attached. I have enclosed two copies in case you would like to keep one for your own information.

Please answer the questions to the best of your knowledge. If you are new in the community you might seek out another to help you with the answers.

Your help in this assessment is greatly appreciated. Thank you for your time in completing this questionaire. A postage paid return envelope is included for your convenience.

Sincerely yours,

George W. Carté, Geophysicist

enc.

APPENDIX A cont. Questionnaire for larger communities and warning points.

TSUNAMI SAFETY QUESTIONNAIRE

Alaska Tsunami Warning System
Palmer Seismological Observatory

1. What office or agency is responsible for warning in your community? _____

2. Who is in charge of this office? _____

3. Is there a telephone that would be answered 24 hours daily? _____

4. If not 24 hours, how many hours on the average? _____ hours

5. Number of this phone _____. Person/Agency answering _____

6. By what method(s) do you receive your warning? _____ _____

7. Do you consider this method(s)reliable and adequate? _____ _____

8. Suggested improvements? _____

9. Are there people, schools, stores, etc. within one mile of the beach and at an elevation of less than 100 feet above sea level?

   None? _____ Few? _____ Many? _____

10. What other communities do you warn? (List below, use reverse if necessary.

_____	_____
(community)	method(telephone, trooper, radio, RCA radio, etc.)

APPENDIX A con't. Questionnaire for small communities.

TSUNAMI SAFETY QUESTIONNAIRE

Alaska Tsunami Warning System
Palmer Seismological Observatory

1. What is the population of your community? _____

2. If it varies significantly seasonally, indicate variation:

_____

3. Does your community have telephone service? _____ Is there a telephone that would be answered 24 hours daily?

_____

4. If not 24 hours, how many hours on the average? _____ hours.

5. What is the number of this phone? _____

6. Name of person, agency, etc. answering phone: _____

7. Do you have a radio-phone? _____ Other radio? _____ Call sign? _____

8. Through whom are you reached on the radio? _____

9. Is the radio manned 24 hours a day? _____ If not, how many?

_____

10. Any other type of communication that could be used to warn your community in an emergency? (Specify) _____

11. Are there people, schools, stores, canneries, etc. within one mile of the beach and at an elevation of less than 100 feet above sea level?

None?_____ Few? _____ Many? _____ All? _____

12. Name (and title) of person preparing this questionnaire:

_____

APPENDIX A con't. Questionnaire for logging camps.

TSUNAMI SAFETY QUESTIONNAIRE

Alaska Tsunami Warning System
Palmer Seismological Observatory

1. What is the population of your logging camp? _____

2. If the population varies significantly seasonally, indicate variation: _____

3. Does your camp have telephone service? _____ Would it be answered 24 hours daily? _____ If not, how many on the average? _____ hours What is the phone's number? _____ Name of person, office, etc. answering phone: _____

4. Do you have a radio-phone? _____ Call sign: _____ Through whom are you reached on the radio-phone? _____ Is the radio-phone manned 24 hours daily? _____ If not, How many? _____ By whom? _____

5. Is there any other type of communication that could be used to warn your camp in an emergency? (Specify) _____

_____

6. Are there homes, schools, sawmills, etc. within one mile of the beach and at an elevation of less than 100 feet above sea level? _____

7. What is the physical location of your logging camp? (Example: Jack Bay on N.E. side of Totem Island). _____

_____

COMMUNITY (1970 pop.) / FACTORS	TSUNAMI HAZARD	COMMUNICATIONS	TSUNAMI PLAN	SIREN SYSTEM	POLICE DEPT.	FIRE DEPT.	SAFE AREAS	SUPPLIES/EQUIPMENT	FACILITIES VULNERABLE	STRUCTURES VULNERABLE	TOTAL RATING
Adak (5000)	H	6	2	2	3	3	3	3	3	2	27
Anchorage (48000)	L	6	2	2	3	3	3	3	3	4	29
Anchor Point (2400)	M	3	0	0	0	2	3	2	3	4	17
Auke Bay (490)	M	3	2	2	1	2	1	3	3	4	21
Chignik (80)	H	3	0	1	0	1	1	1	1	1	9
Cohoe (50)	M	3	0	0	0	0	3	3	3	4	16
Cold Bay (260)	M	4	2	0	2	3	3	3	3	4	24
Cordova (1200)	M	6	2	3	3	2	3	3	2	3	27
Craig (270)	M	3	0	3	0	2	3	2	2	2	17
Douglas (1200)	L	3	2	2	1	3	3	3	2	3	23
English Bay (105)	H	2	0	0	0	0	3	1	2	4	12
Halibut Cove (25)	M	2	0	0	0	0	1	1	1	1	6
Homer (2000)	H	4	2	4	3	2	2	3	3	3	26
Hydaburg (380)	L	3	0	0	0	2	3	2	3	3	16
Juneau (6000)	L	6	2	2	3	3	3	3	3	3	28
Kachemak (225)	M	3	0	0	0	0	3	3	3	4	16
Kenai (5700)	M	6	2	0	3	3	3	3	3	4	27
Ketchikan (7000)	L	6	2	2	3	3	3	3	1	2	25
King Cove (280)	H	3	0	3	0	2	1	1	1	0	11
Klawock (210)	M	2	0	0	0	2	2	1	1	3	11
Kodiak (4900)	H	6	2	3	3	3	3	3	2	2	27
Kodiak USCG (2000)	H	6	2	3	3	3	3	3	2	2	27
Kupreanof (40)	L	1	0	2	0	0	1	1	0	1	6
Lena Cove (300)	L	3	2	2	1	2	1	3	3	4	21
Nikiski (4500)	M	3	2	0	1	3	3	3	3	4	22
Nikolski (60)	H	3	0	0	0	1	2	1	1	1	9
Ninilchik (250)	M	3	0	0	0	0	3	2	3	2	13
Old Harbor (330)	H	2	0	0	0	0	1	1	0	0	4
Perryville (90)	H	1	0	0	0	1	1	1	1	0	5
Petersburg (2000)	L	3	1	3	3	2	3	2	1	3	21
Port Graham (180)	M	2	0	3	0	0	3	1	3	3	15
Port Lions (240)	M	3	0	0	0	2	3	2	2	2	14
Sand Point (360)	H	3	1	1	0	2	3	2	3	2	17
Seldovia (650)	H	3	0	0	0	2	3	2	2	2	14
Seward (3000)	H	5	2	4	3	3	3	3	3	3	29
Sitka (3400)	H	6	2	2	3	3	3	3	2	2	26
Unalaska (200)	M	3	1	1	3	2	2	2	1	1	16
Yakutat (190)	H	4	0	0	0	2	2	2	3	3	16

Note: For complete description of categories and rating factors see "Tsunami Preparedness Assessment, Rating Factors". This is only an estimate and is subject to change. Under Hazard, H=high, M=moderate, and L=low.

Appendix B. Tsunami preparedness assessment for 38 communities for 1977-78.