

Changing Forest Disturbance Regimes and Risk Perceptions in Homer, Alaska

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Forest disturbances caused by insects can lead to other disturbances, risks, and changes across landscapes. Evaluating the human dimensions of such disturbances furthers understanding of integrated changes in natural and social systems. This article examines the effects of changing forest disturbance regimes on local risk perceptions and attitudes in Homer, Alaska. Homer experienced a spruce bark beetle (*Dendroctonus rufipennis*) outbreak with large-scale tree mortality and a 5,000-acre fire in 2005. Qualitative interviews and quantitative analysis of mail surveys are used to examine community risk perception and relationships with land managers pre- and post-fire. Results show a decrease in the saliency of the spruce bark beetle as a community issue, a coalescence of community risk perceptions about fire, and conflicting findings about satisfaction with land managers and its relationship with risk perception.

KEY WORDS: Alaska; forest disturbance; relationship with land managers; risk perception; spruce bark beetles

1. INTRODUCTION

Managing forest health disturbances by insects and/or disease is particularly challenging given the cascading nature of these events, including further disturbances and risks.⁽¹⁾ What starts as an insect infestation or disease situation in a particular tree species can quickly spread and have profound implications for native and invasive species, soils, animal habitat, and watersheds. In turn, tree mortality can affect erosion and runoff, fire hazards and fuel loading, and forest regeneration. While there is considerable and growing understanding of disturbance ecology,⁽¹⁻⁶⁾ consideration of the human dimensions—people and communities interacting with changing resources and landscapes—is less clear. The varied social and economic impacts, both positive and negative, associated with forest disturbances are beginning to be understood.^(7,8) Whether public reactions and/or shared risk

perceptions change as forest disturbances evolve or cascade from one disturbance to another remains less well understood. This question is addressed here using a mixed-method and longitudinal case study approach in and around Homer, Alaska from 2003 to 2006. Homer, Alaska, and the greater Kenai Peninsula area experienced large-scale tree mortality due to an outbreak of spruce bark beetles (*Dendroctonus rufipennis*) over the last two decades.

2. UNDERSTANDING RISK PERCEPTION IN THE CONTEXT OF FOREST DISTURBANCE

Forest disturbances are likely to evolve over time with changing human dimensions impacts. One way to approach the human dimension of forest disturbances is to think of the potential for such events and their impacts as risks. Risk is typically understood as the calculable probability of a negative event or loss.⁽⁹⁻¹¹⁾ In the case of forest disturbance, risk is the probability that loss or damage will ensue from a loss of natural

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resources due to disturbance or as the result of related hazards affecting lives, property, or values.

Beyond technical, or presumed objective interpretations of risk by forest management professionals, people who live in or near changing forest landscapes are more likely to see the chance for loss through a subjective lens based on their own experience and sociocultural context.⁽¹²⁾ Risk is both an objectively measurable phenomenon and the subject of social construction by people and society.^(12,13) Social, institutional, environmental, and cultural processes shape the way society experiences risk.⁽¹⁴⁾

Research on risk perception has to a certain extent been dominated by a psychometric perspective emphasizing a cognitive and individual approach to risk interpretation.^(15,16) A somewhat alternative perspective advocated in this article posits that risk perception is socially constructed by individuals and often coalesces at the community level where risks are collectively experienced by people whose lives interconnect in various ways in various places.^(12,13,17-19) Community risk perceptions, therefore, are defined as the collective expressions of anxiety, fear, or concern due to a commonly understood threat of loss or harm to community residents, property, and/or values.

A number of factors have been described in the literature on risk, disaster, and community and natural resources as influencing community risk perception. Fig. 1 shows a conceptual framework that outlines factors influencing community risk perception and shapes the analytical approach in this article. The

risk context is interpreted here not only as a function of biophysical vulnerability found in changing landscapes, but also as influenced by socioeconomic vulnerabilities. In addition, community risk perception is best framed, not merely as a direct consequence of the risk context, but also as influenced by the local relationship or satisfaction with land managers, proximity to hazards, and community experience with emergencies.

Shared community experience with emergencies or disturbance impacts contributes to a shared community identity.⁽²²⁾ By sharing risk experiences, a community risk perception coalesces and filters individual perceptions.^(13,17) Natural resource-based communities experience risks that are often a blend of natural and social processes, including fire and floods^(23,24) that increase awareness of environmental processes. Perceived proximity to hazards, reflecting geographic and environmental factors, is also understood to influence risk perception.^(25,26)

In addition, the risk literature suggests that risk perception is influenced by levels of trust or confidence in risk mitigating authorities or entities.^(18,27-33) Such "groups" are normally seen as being entrusted with minimizing concern about possible risk in their performed duties and responsibilities.⁽³³⁾ Freudenburg⁽³⁴⁾ said public trust is valuable, but fragile. The problem of recreancy, or the failure of institutions to carry out their responsibilities has had detrimental effects on confidence in expert judgments of risk and increases risk perception.⁽³⁵⁾ Earle and Siegrist,

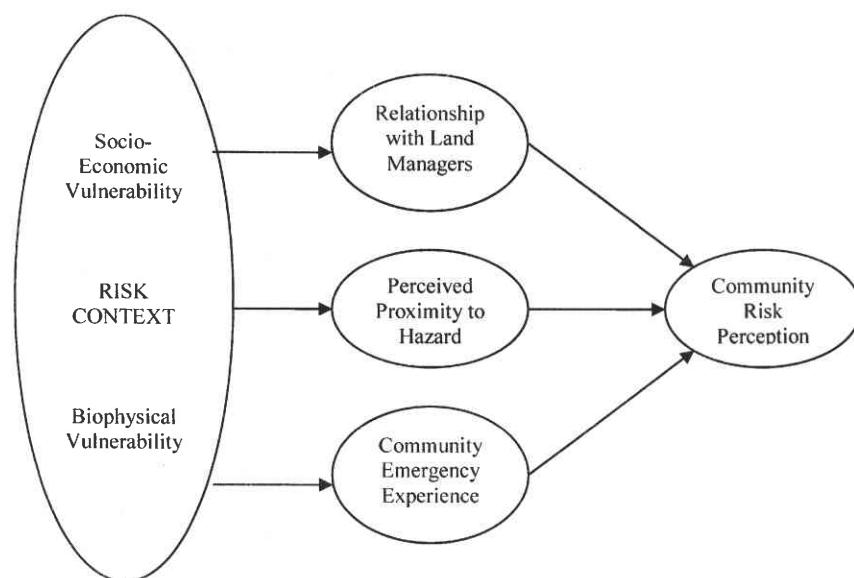


Fig. 1. Conceptual model of community risk perception adapted from conceptual framework by Flint and Luloff.^(20,21)

however, suggested that while confidence in the performance of organizations may be fragile, trust based on shared values may be more resilient.⁽³³⁾

This conceptual model of community risk perception was empirically evaluated in the context of forest disturbance by spruce bark beetles in six communities on the Kenai Peninsula.^(7,20,36) This article evaluates how the perceptions of residents changed over time in one of those communities, Homer, Alaska, as changes occurred in the forest disturbance regime and how related risk experiences may have altered risk perceptions and relationships with land managers.

3. SITE DESCRIPTION

Homer, Alaska is situated on the southern tip of the Kenai Peninsula in south-central Alaska. The forests in and around Homer experienced a large-scale disturbance by spruce bark beetles (*Dendroctonus rufipennis*), which led to approximately 90% mortality among spruce trees. This community is colloquially referred to as a "Cosmic Hamlet by the Sea." Homer looks out over sweeping views of stunning mountains, glaciers, and the Kachemak Bay. Homer's natural amenity-based tourism and recreation provide much of the community's economic base. In 2000, the greater Homer area population was 8,920.¹ It is an environmentally oriented community, known for its liberal political orientation. However, a quieter conservative component of its population reflects Alaska's reputation for rugged individualism and antigovernment sentiment.

Spruce bark beetles dramatically changed the forest landscape in and around Homer. A small fire (200 acres) burned in beetle-killed spruce near Homer in 1999 along with other small fires in the last few years, but there were no large-scale fires until late April, 2005, when the Tracy Avenue fire burned over 5,000 acres. The Tracy Avenue fire started with a cracked power line insulator. Only one structure, an uninhabited cabin, burned in the fire. The fire occurred in late April and early May, prior to the start of the official fire season, which is typically June–August as described by local fire managers. This timing contributed to a delay in fire management response as

fire-fighting equipment was not located on the Kenai Peninsula. The fire moved in a northwest direction due to winds from an unusual direction, keeping the fire away from Homer. The remainder of this article examines whether this evolving forest disturbance situation contributed to changing attitudes within the Homer community.

4. METHODS

A mixed methodological framework emphasizes the opportunity to bring multiple viewpoints or ways of knowing and appreciating a range of concepts and issues to bear on the same research questions.⁽³⁸⁾ Incorporating qualitative and quantitative data, acquired in different circumstances at multiple points in time, allows a rich, narrative expression to describe the range of variation in and experience with concepts being measured to provide context for further quantitative assessments of a larger population that can be used to promote generalizability of overall research findings.⁽³⁹⁾ While each methodology has inherent limitations, a mixed methods approach combines complimentary strengths.⁽⁴⁰⁾

In 2002, a study was undertaken to examine variations in community response to the spruce bark beetle outbreak on the Kenai Peninsula. Homer was one of six communities studied using both qualitative key informant interviews and quantitatively analyzed mail surveys.^(7,20,36) In 2003, 35 key informant interviews were completed in Homer. Key informants are individuals who, based on their formal or informal position within a community, are knowledgeable about community affairs and are representative of local interest groups and social status levels.⁽⁴¹⁾ Combined criterion and snowball sampling procedures were used to identify key informants.⁽⁴²⁾ For the criterion frame, at least one key informant from each of the following groups was interviewed: (1) school administrator or teacher; (2) business owner; (3) librarian; (4) government leader or member of a local planning commission; (5) local clergy; (6) fire or police representative; (7) community service administrator or healthcare provider; (8) representative of the logging industry; (9) representative of an environmentalist organization; (10) newspaper journalist or media representative; (11) homesteader or long-time resident; and (12) newcomer. Informants were then asked to identify others they considered knowledgeable about the community or who represented important local interests.⁽³⁹⁾ Key informants were interviewed until redundant information was collected.

¹ This population figure was drawn from a list of residents who had received the Alaska Permanent Fund Dividend (PFD), a percentage of yearly oil revenue taxes that are distributed to eligible Alaskans by the State of Alaska.⁽³⁷⁾ This incentive ensures that the PFD is a relatively complete list of Alaska residents and a more accurate accounting of population than the U.S. Census which has a low sampling rate.⁽³⁷⁾

In 2004, a 16-page mail survey was sent to 800 residents randomly selected from a database of Homer residents compiled using the Alaska Permanent Fund Dividend list.⁽³⁷⁾ The Homer surveying effort resulted in 366 completed surveys representing a 48% response rate after accounting for undeliverable surveys. Data collected from the 2003–2004 study provided baseline information for Homer resident perspectives prior to the 2005 Tracy Avenue fire.

Following the Tracy Avenue fire, additional data were collected through follow-up telephone interviews and mail surveys. In the summer of 2005, 21 of the 35 original key informants from Homer were interviewed. The remaining 14 key informants from 2003 could not be reached. A semistructured interview protocol was used with open-ended questions. Interviews were tape recorded, transcribed, and analyzed by the investigator. Mail surveys were administered in 2006 to the 366 original respondents from the 2004 survey. In the 2006 mail survey, 233 household surveys were received. Accounting for undeliverable surveys, the 2006 response rate was 74%. In summary, this article draws upon data collected at four points in time, which is analyzed using both qualitative and quantitative methods.

Comparison of sociodemographic data between the survey samples and U.S. census data showed the samples to be generally representative of the population, with the sample as moderately more educated and having slightly higher incomes. The incongruity of census designated places and the actual communities in Alaska makes precise comparison difficult. One important note is that the U.S. census indicated the Alaska Native population in the Homer area to be 3.6% in 2000. The 2004 survey sample was 3.9% Alaska Native and the 2006 sample was 4.6% Alaska Native. Despite the presence and activities of Alaska Native Corporations and residents on the Kenai Peninsula, Alaska Natives do not constitute a large portion of the Homer population. Comparing the 2004 and 2006 samples, there were no significant differences in the socioeconomic variables including age, gender, years in community, race and ethnicity, household income, or educational attainment.

Concepts from the conceptual model were measured at multiple points in time using both interview and survey methodologies. Citizen satisfaction with forest resource managers is used in this article as an indicator of confidence in past performance by land managers (described as the relationship with land managers). Proximity to hazard was measured

in surveys by two questions referring to the perceived degree of mortality in nearby spruce forests and the perceived amount of natural regrowth of spruce trees. The relevant experience with emergencies in this case is the occurrence of forest fire. Risk perception was operationalized as levels of concern about various threats stemming from the disturbance by bark beetles. While surveys were conducted with individuals, interpretation of the coalescence of community risk perception is guided by examining both qualitative narratives and the quantitative change in standard deviation in indicators from the same samples at two points in time.

5. RESULTS FROM INTERVIEWS IN 2003

5.1. The Context of the Spruce Bark Beetle Issue

It was clear in 2003 that the spruce bark beetle outbreak had been a devastating experience. The issue was still a fairly salient part of local conversation but the emotional intensity of the experience was starting to fade:

Had you asked me this 4 years ago my answer would have been much more "devastating!" I would've said things like, "it's ripping at the core of the community." Everybody's done such a good job just rolling with the punch and dealing with it. When it first was coming in a mass, that's what it felt like. The first time you were outside in the yard and more than 6 beetles landed on you at one time, it was terrifying. It was devastating. But, then you realized that we were all going through it and we all lived through it. All it does is change what your property looks like. I guess it's not as devastating as I felt that it was originally.

People in Homer have been very, very resistant to anything that threatens their environmental surroundings. So, to have this come through totally out of their control was very emotionally upsetting for a lot of people. Very sad. A number of people just looked at their dead trees and just sobbed.

There was a sense of optimism among Homer residents that young, unaffected trees were doing well and that if the forests were not harvested or clearcut, they would regenerate over time:

I'm convinced the forest will be just fine as long as man doesn't become so impatient that he doesn't bring in a bunch of bulldozers and ruin all of the root mass and ruin all of the vegetation and ruin the protection canopy. This is actually a very natural process going on here and it's very pleasant to sit back and watch as long as you just have patience. The younger surviving trees are clearly doing really well.

5.2. Relationship with Land Managers

Overall, Homer residents were significantly disappointed with forest managers and their efforts to deal with the spruce bark beetle. Interviews revealed little satisfaction with land managers, particularly the Kenai Peninsula Borough, Alaska State Forestry, and local native associations. Many respondents indicated a lack of confidence in land management decisions:

Watching the government's poor choices started to undermine confidence in agencies and government on how to deal with it [the bark beetles] – their lack of rapid response A, and B, their poor choices in my mind. All of a sudden I lost all the faith in government officials that I possibly had going into it all.

Many felt that not enough was done about the bark beetle situation. There was vocal criticism of the effects of timber harvesting. It deserves mention that Homer differed greatly from other Kenai Peninsula communities in this regard as most other community residents felt that not enough timber harvesting had been done. Homer residents, like other community residents, felt that a lot of money had been spent, but they questioned decisions and actions across the board:

DNR, the division of forestry, pretty much wants to sell logs. But they wanted to do that prior to the beetle kill. The beetle kill gave them a new rallying cry—salvage logging. For the most part, no matter what the administration has been since I got here, there's been a strong emphasis on trying to do as much resource extraction as possible. They might pay lip service to issues of conservation, but I've never found them to be very concerned. There's always been an economic edge to everything.

5.3. Fire Experience and Other Emergencies

There was little mention of fire experience by Homer residents in 2003. The Mansfield Fire (also referred to as the Hutler Road Fire) in 1999 was the only fire mentioned and there was little sense that the fire threatened more than a few residents or burned more than a couple acres (in fact it burned nearly 200 acres). Respondents were generally positive about the response to that fire and overall fire fighting efforts in the area:

We've been pretty fortunate in that during the period when the trees died and there was the high risk, we've only had very small fires that got put out right away. So, I don't think there's any memory of a disaster fire.

The only fire that caused a good bit of concern, probably once again more than it deserved, was the fire that occurred 4 or 5 years ago in the Hutler Road area. I'm

sure you've heard of it before – The Mansfield Fire. There was a good bit of concern. It could be seen from the end of the spit. You could see the smoke and actually the fire. But it was quite quickly contained. It only burned about 10 acres. There was a lot of dry timber in front of it and it could've gotten a lot of homes out in that area, but there was very little damage other than it burned some dead trees.

Beyond fire experience, residents recalled flooding in 2002 as a significant event for the community and some respondents linked the extreme runoff to changes in forest conditions due to the spruce bark beetle. Overall, community response to emergencies, including the 1964 earthquake and the Exxon Valdez oil spill, was seen as very positive and helpful.

5.4. Risk Perception

Homer residents were split on risk perceptions of fire. Some felt that fire risk was being "hyped" to promote logging. This sentiment was unique to Homer residents:

The perception for a lot of people is that dead spruce trees are a phenomenal fire hazard in comparison with a live forest. I think there are two reasons for that. One is simply lack of experience. The other is that it's been pumped as a way to get money from federal programs. It's a way for people to build a forest products industry and move that forward.

Some residents felt that green trees, those unaffected by spruce beetles, were as risky in terms of fire as dead trees.

In addition to fire risk posed by green and beetle-killed forests, many residents were very concerned about grass fires, particularly in the spring.

The dead grass is the most volatile thing you've ever seen. If you poured kerosene on it, it wouldn't be any more volatile.

A native, but invasive grass species, the Bluejoint reed grass (*Calamagrostis canadensis*), thrives in areas opened due to tree mortality and grows to around six feet tall. During the dry spring months before the grass greens up, these dry grasses are a major fire hazard. This was recognized by numerous residents in the 2003 interviews. Some residents also mentioned concerns about having only one road in and out of the Homer area, which is situated at the south end of the peninsula.

While perceptions of fire risk were mixed, there was considerable concern by respondents about the effects of logging beetle-killed trees on watersheds, fish and wildlife habitat, the future of the forest, and

overall scenic integrity of the area. Risk perception from natural causes was not a significant topic of discussion. There appeared to be a direct link made by many Homer respondents between the lack of faith in the forest industry and their perceptions of risk. As one resident remarked, "A lot of the changes in ecosystem dynamics are a consequence, not of the beetle kill, but of the reaction to the beetle kill." In 2003, Homer's propensity to disagree over issues was highlighted, signifying an incomplete coalescence of community risk perception:

Take any issue and roll it down the street and people will jump to take sides. Roll it down again and they'll jump again just to be sure they don't agree.

6. RESULTS FROM SURVEYS IN 2004

6.1. Univariate Analysis

Survey data collected in 2004 provided additional insight on relationships with land managers and risk perceptions. No significant fires or other forest-related emergencies occurred between the time of the 2003 interviews and the administration of the mail survey in early 2004. Three-quarters of the respondents (74.7%) felt that a majority of spruce trees were dead while only a third (34.4%) felt that there had been substantial regrowth of new spruce trees. Survey results from 2004 indicated that risk perceptions were relatively high among Homer respondents, espe-

Table I. Survey Results on Risk Perceptions^a

Concern About Forest Risks	2004 Percent		N
	2004 Mean ^b	Highly Concerned ^c	
Forest Fire	4.06	73.9	360
Loss of Scenic/Aesthetic Quality	3.66	61.1	357
Grass Fire	3.64	58.8	357
Increased Erosion and Runoff	3.61	59.8	353
Falling Trees	3.55	56.9	355
Decline in Fish and Wildlife Habitat	3.27	46.6	354
Loss of Forest as an Economic Resource	2.97	34.7	354
Loss of Community Identity Tied to the Forest	2.84	30.7	351

N = Sample size.

^aSurvey question read, "How concerned are you about each of the following forest risks for your community?"

^bBased on 5-pt scale (5 = Extremely Concerned to 1 = Not Concerned).

^cPercentage of respondents indicating 4-5 on 5-pt scale (5 = Extremely Concerned to 1 = Not Concerned).

Table II. Survey Results on Satisfaction with Land Managers in 2004^a

Land Manager	2004 Percent Satisfied ^b	N
Private Landowners	34.4	291
AK State Forestry	23.6	271
AK State Parks	27.5	265
US Forest Service	22.4	250
Kenai Peninsula Borough	25.3	293
Native Associations	16.3	257

N = sample size.

^aSurvey question read, "Please circle the number that represents your general level of satisfaction or dissatisfaction with how the spruce bark beetle epidemic has been managed by each of the following entities."

^bPercentage of respondents indicating 4-5 on 5-pt scale (5 = Very Satisfied to 1 = Very Dissatisfied).

cially relating to forest fire (see Table I). Over half of the respondents had high-to-extreme risk perceptions concerning forest fire (73.9%), loss of scenic or aesthetic quality (61.1%), increased erosion and runoff (59.8%), grass fire (58.8%), and falling trees (56.9%).

Table II shows results from the 2004 survey measuring the level of satisfaction with various land management entities including private landowners. Satisfaction with private landowners as land managers was higher (34.4%) than with any of the other land management entities. Native associations had the lowest levels of satisfaction (16.3%).

Table III. Varimax Rotated Factor Loadings for Risk Perception Items, Homer, Alaska, 2004

Factors/Items	Factor 1	Factor 2
Immediate threats to property and safety		
(a) Concern about forest fire	0.072	0.881
(b) Concern about grass fire	0.230	0.747
(c) Concern about falling trees	0.187	0.756
Broader threats to community and ecological well-being		
(d) Concern about decline in fish and wildlife habitat	0.709	0.211
(e) Concern about increased erosion and runoff	0.708	0.345
(f) Concern about loss of community identity	0.844	0.057
(g) Concern about loss of forest as an economic resource	0.561	0.182
(h) Concern about loss of scenic/aesthetic quality	0.820	0.060
N	352	343
Eigenvalue	3.483	1.423
% of cumulative variance	43.536	17.790
Cronbach's alpha	0.805	0.742

6.2. Factor Analysis and Bivariate Correlations

Factor analysis of the Homer risk perception data from 2004 revealed that risk perceptions fell into two distinct factors: (1) perception of immediate risks to personal safety and property (including forest fire, grass fire, and falling trees) and (2) perception of broader risks to ecological and community well-being beyond immediate hazards (including increased erosion and runoff, loss of habitat, loss of forest as an economic resource, loss of scenic and aesthetic quality, and loss of community identity). Table III shows results of factor analysis of these variables by extracting principal components using varimax rotation.⁽⁴³⁾ The two resulting risk perception factors were correlated but not collinear. Cronbach's alpha-reliability coefficients for these factors were 0.742 for immediate risks from forest fire, grass fire, and falling trees ($\alpha = 3.76$; $SD = 0.971$) and 0.805 for broader risks to community and ecological well-being ($\alpha = 3.27$; $SD = 0.915$).

Factor analysis of Homer land management satisfaction data from 2004 revealed one distinct factor for government land managers including the Kenai Peninsula Borough, AK State Forestry, AK State Parks, and USDA Forest Service (See Table IV). Satisfaction with individual property owners and native associations did not factor reliably. Cronbach's alpha-reliability coefficient for this factor was 0.899 ($\alpha = 2.70$; $SD = 0.974$). Composite indexes were created for the two sets of factored items on risk perception and the set related to satisfaction with government land managers. Bivariate relationships were examined revealing no significant relationship between risk perception variables and satisfaction with government land managers for the 2004 Homer data.

Table IV. Factor Loadings for Satisfaction with Land Manager Items, Homer, Alaska, 2004

Factors/Items	Factor 1
Satisfaction with government land managers	
(a) Kenai Peninsula Borough	0.813
(b) AK State Forestry	0.943
(c) AK State Parks	0.842
(d) U.S. Forest Service	0.903
<i>N</i>	222
Eigenvalue	3.075
% of cumulative variance	76.868
Cronbach's alpha	0.899

7. RESULTS FROM INTERVIEWS IN 2005 (POST TRACY AVENUE FIRE)

7.1. Reaction to Fire Fighting Efforts

Over half of those interviewed in 2005 indicated frustration with the fact that the fire season did not include the often dry conditions in April and May. Moreover, there was dissatisfaction among residents about the delayed deployment of fire fighting equipment to fight the Tracy Avenue fire:

Clearly State Forestry were caught with their pants down on this because it was way ahead of the fire season. So, they weren't really mobilized and there were no tankers for a long time with retardant.

Despite this frustration, Homer residents interviewed were generally very satisfied with the fire fighting efforts and the flow of information to the public:

I think that the general public thought that they got in there and they kept them informed and didn't screw them around and try to feed them phony information or avoid them or any of those things that sometimes officials make the mistake of trying to do. And they worked hard and they got the job done. I think people are really satisfied with that.

Another area of satisfaction among those interviews was the way in which locals were allowed and encouraged to be involved in fire fighting efforts:

We had local volunteers. Four big equipment operators came out completely voluntarily and they created the fire lines. They had the fire fighters behind them but they were essential to fighting the fire. They were all locals, born and raised here and they knew the country. Local citizens came with sandwiches and were feeding the firefighters. The local residents were just marvelous. Forestry came in and took over command at the McNeil School and it worked out wonderful.

7.2. Saliency of the Spruce Bark Beetle and Attitudes Toward Forest Management

The spruce bark beetle issue was not as salient an issue in 2005 as it was in 2003 among those (re)interviewed:

For the average person, the spruce bark beetle has come and gone as an important issue. People have gotten used to the drabness of the forest.

There were also very few negative sentiments about forest management by those key informants interviewed in 2005. In general, it appeared that vocal opposition to agency forest management decisions was less prevalent:

Now, because these aren't impact issues anymore personally, there are more positive feelings on both sides about forest management than when the battle lines were drawn. It's not emotional anymore. Decisions were made 15 years ago. It's all a moot point because it's done. People are no longer interested.

You don't hear to log or not to log anymore. That debate has subsided. There is agreement now. Those parcels that were in debate have been acted on. There's no wringing of hands anymore. There's no new action or seeking information about what to do anymore.

Most respondents linked what they perceived as a growing general satisfaction in forest management to the Tracy Avenue fire fighting efforts that were highly regarded:

Overall people here aren't that worried. They know that if there's a fire, the state forestry people and other people in fire management might not be able to stop it because of wind conditions or things you can't control, but they will do the best they can. There's a lot of confidence that they will do the best they can with the resources they have. The community has a lot of confidence in forest fire management. I think it carries over to forest management in general. If they weren't confident, I think there would be more public participation to get something done.

7.3. Risk Perception

Fire risk perception appeared to be somewhat higher in 2005 than in 2003, with many respondents suggesting that the Tracy Avenue Fire brought attention to the fire hazard and mobilized local action in terms of creating defensible space and reducing risks to property:

It's not much on the forefront, but it reminded us how susceptible we are here. More people are clearing around their house and creating defensible space. It's made people aware that we are at risk here.

It was also clear in the interviews that Homer residents are particularly concerned about the risk of grass fire, particularly in the spring, and the need for fire preparedness efforts year round:

Our biggest issue here is not timber but the grasses that burn very hot and very quick. It's certainly dangerous. There is more talk about fire prevention and the reality of fire. Things like emergency procedures and evacuating people.

Everybody's nervous. They should be nervous with the spruce bark beetle. Even after the grasses green up on the ground and are less likely to burn, there is still all of the dead trees. A crown fire could be a real disaster. People are very concerned and it's well founded.

While not mentioned extensively in the 2005 interviews, some Homer residents voiced concerns about issues beyond fire such as fish and wildlife habitat and effects on watersheds:

The climax forest is 90% gone. We don't hear or see the birds we used to. I saw one woodpecker in the last year. We used to have four different species here and now I can't hear or see them. The biomass is way down. Some mammals are crashing too. There are no red squirrels because they have no food. It's a silent forest. Eventually as the trees come down and the grasses come in there will be less black bear.

Also concerned about wildlife habitat, another resident stated that:

My concern is the volume of dead trees. It's a nightmare for wildlife to move from one area to another. There's not really the moose through my property that there used to be. You'd have to be an Olympic gymnast to get through the volume of dead trees.

Despite sentiments about changes in habitat and impacts to water quality due to logging, there was not an overwhelming concern about broader risks to ecological well-being present in the interview data. It appeared that those concerned were in more of a professional position to see potential impacts:

Fire is the main concern. People are not really concerned about watersheds. Only professional people think about that. There aren't a lot of armchair conservation biologists out there. Cook Inlet Keeper is certainly monitoring water quality to check to see if there's an impact on salmon streams but that's focused on the effect of logging and forest management, not the natural disturbance itself.

In summary, there was greater consensus among those interviewed in 2005 about the risk of fire in the area, but there was less discussion in general about broader impacts or potential impacts from the spruce bark beetle activity.

8. RESULTS FROM SURVEYS IN 2006

8.1. Univariate Analysis and Pre- and Post-Fire Comparison

Survey results from 2006 showed that concern about forest fire still had the highest risk perception (see Table V). While the mean for this concern decreased slightly, the percentage of respondents highly or extremely concerned stayed the same from 2004 to 2006 but the standard deviation around the mean declined, indicating coalescence in community risk

Table V. Survey Results on Risk Perceptions in 2006

Concern About Forest Risks	2004 Mean (Standard Deviation)	2006 Mean ^a (Standard Deviation)	2004 Percent Highly Concerned ^b	2006 Percent Highly Concerned ^b	N
Forest Fire	4.08 (1.12)	3.96 (.98)	73.6	73.1	227
Loss of Scenic/Aesthetic Quality	3.68 (1.12)	3.56 (1.17)	61.5	56.1	226
Increased Erosion and Runoff ^c	3.68 (1.12)	3.29 (1.14)	63.0	47.5	225
Grass Fire	3.66 (1.22)	3.64 (1.09)	58.1	59.4	227
Falling Trees ^c	3.53 (1.13)	3.35 (1.17)	55.9	46.2	225
Decline in Fish and Wildlife Habitat ^c	3.34 (1.23)	3.11 (1.15)	50.2	37.9	227
Loss of Forest as an Economic Resource	2.94 (1.22)	2.73 (1.18)	33.8	25.7	225
Loss of Community Identity Tied to the Forest	2.87 (1.28)	2.78 (1.19)	31.0	25.5	227

N = Sample size (maximum sample with both 2004 and 2006 data).

^aBased on 5-pt scale (5 = Extremely Concerned to 1 = Not Concerned).

^bPercentage of respondents indicating 4–5 on 5-pt scale (5 = Extremely Concerned to 1 = Not Concerned).

^cDifferences between 2004 and 2006 for these categories are statistically significant at the $p < 0.05$ level.

perception on fire. The percentage of respondents who were highly concerned about grass fire increased from 2004 to 2006, though the mean for this variable decreased slightly. The standard deviation declined for the grass fire concern variable indicating greater coalescence in risk perception. All other risk concerns declined based on both the mean risk perception score and the percentage indicating high or extreme concern. The difference between 2004 and 2006 data was statistically significant for falling trees, decline in fish and wildlife habitat, and increased erosion and runoff. All other differences between 2004 and 2006 were not statistically significant. There was no change in the survey findings on proximity to hazard related to perceived degree of spruce mortality or regrowth of new spruce.

Survey data from 2006 revealed that satisfaction with how the spruce bark beetle outbreak had been managed declined in every category (see Table VI).² Analysis using paired *t*-tests revealed no significant differences between the 2004 and 2006 results, but percentages of those indicating they were satisfied or very satisfied (4 or 5 out of a 5-point scale where 1 = "very dissatisfied" and 5 = "very satisfied") declined for all land management categories. The category with the greatest decrease in satisfaction was private landowners.

² The sample size for the survey data in 2006 was smaller than in 2004. Comparisons of univariate findings between years are based only on those who responded to both surveys. Differences between data from the larger 2004 sample and the 2004 data with only those who responded in 2006 were not significant for any variables.

Table VI. Survey Results on Satisfaction with Land Managers in 2004 and 2006

Land Manager	2004 Percent Satisfied ^a	2006 Percent Satisfied ^a	N
Private Landowners	30.9	20.8	181
AK State Forestry	28.5	21.6	172
AK State Parks	28.4	24.9	169
U.S. Forest Service	26.4	18.3	159
Kenai Peninsula Borough	25.7	22.0	183
Native Associations	16.0	14.1	157

N = sample size (maximum sample with both 2004 and 2006 data).

^a4–5 on 5-pt scale (5 = Very Satisfied to 1 = Very Dissatisfied).

8.2. Factor Analysis and Bivariate Correlations

Factor analysis of the 2006 Homer risk perception data revealed the same factors from 2004 with one exception. Perception of broader risks to ecological and community well-being factor did not include loss of forests as an economic resource (see Tables VII and VIII). The Cronbach's alpha-reliability coefficients were 0.751 for immediate risks ($\alpha = 3.657$; $SD = 0.879$), 0.807 for broader risks ($\alpha = 3.212$; $SD = 0.968$), and 0.912 for satisfaction with government land managers ($\alpha = 2.89$; $SD = 0.917$).

Composite indexes were created for the two sets of factored items on risk perception and the set related to satisfaction with government land managers. Bivariate relationships were examined revealing a significant negative relationship between perceptions of broader risks to ecological and community well-being and satisfaction with government land managers ($r = -0.181$; $p = 0.009$; $N = 209$). In other words,

Table VII. Varimax Rotated Factor Loadings for Risk Perception Items, Homer, Alaska, 2006

Factors/Items	Factor 1	Factor 2
Immediate threats to property and safety		
(a) Concern about forest fire	0.166	0.875
(b) Concern about grass fire	0.203	0.835
(c) Concern about falling trees	0.153	0.693
Broader threats to community and ecological well-being		
(d) Concern about decline in fish and wildlife habitat	0.793	0.210
(e) Concern about increased erosion and runoff	0.798	0.276
(f) Concern about loss of community identity	0.825	0.071
(g) Concern about loss of scenic/aesthetic quality	0.712	0.164
<i>N</i>	229	228
Eigenvalue	3.327	1.311
% of cumulative variance	47.534	18.725
Cronbach's alpha	0.807	0.751

Table VIII. Factor Loadings for Satisfaction with Land Manager Items, Homer, Alaska 2006

Factors/Items	Factor 1
Satisfaction with government land managers	
(a) Kenai Peninsula Borough	0.825
(b) AK State Forestry	0.947
(c) AK State Parks	0.856
(d) U.S. Forest Service	0.926
<i>N</i>	212
Eigenvalue	3.168
% of cumulative variance	79.192
Cronbach's alpha	0.912

respondents with lower levels of satisfaction were more likely to have higher risk perceptions related to broader threats to ecological and community well-being. No significant relationships were found between perception of immediate risks (forest fire, grass fire, and falling trees) or concern about the loss of forest as an economic resource and satisfaction with government land managers.³

³ Bivariate correlations were examined for all variables related to individual risk perception and satisfaction with land managers. Results did not reveal any significant relationships between risk perception of immediate threats from forest fire, grass fire, or falling trees with any of the individual satisfaction with land manager variables. The only significant relationships were with risk perceptions of broader risks to ecological and community well-being as described above.

9. DISCUSSION AND CONCLUSIONS

Based on comparison of data collected in 2003 and 2004 (prior to the Tracy Avenue Fire) and the data collected in 2005 and 2006, it appears that changes in the forest disturbance regime around Homer were associated with changes in the social construction of risk among community residents. The saliency and contentiousness of the spruce bark beetle issue appeared to decline in Homer, thus furthering a trend that was described in 2003 toward a less emotional response by local residents.

Risk perception appeared to coalesce about fire hazard concern in Homer. By 2005, there was less debate about fire hazards and the distinction between green and dead trees. Survey results in 2006 showed that the overall percentage of people that were highly concerned had not changed but an examination of the two data sets revealed a decrease in standard deviation in scores concerning fire risk perception over time. Further, it appeared that concern about grass fire was as high or higher after the Tracy Avenue fire. Fire-related risk perceptions were substantial in the summer of 2005 after the fire and remained high into 2006 when residents were surveyed. Standard deviations for grass fire ratings also decreased indicating greater community coalescence of risk perception related to grass fires. Beyond fire concerns, all other risk perceptions about potential impacts such as falling trees or broader threats to community and ecological well-being decreased in intensity, though they were still mentioned by some in the 2005 interviews.⁽³⁶⁾

Conflicting results were found in the relationship between local residents and land managers. Interview data in the summer of 2005 suggested a rather dramatic increase in satisfaction with land managers. By the 2006 survey with a larger sample, satisfaction with land managers was considerably lower for all categories than in 2004. This may suggest that in the immediate aftermath of the fire, residents were still reacting to the successful fire fighting experience and that such confidence and positive response did not last over time. It may also be possible that small group of key informants held an alternative perspective about land managers than the larger population.

The qualitative findings suggest that fire fighting efforts in 2005 were viewed very positively and may have reduced the public perception that land managers had been recreant in their handling of forest management in general.⁽³⁵⁾ By 2006, survey results

showed that despite the temporary satisfaction with forest managers in the wake of the Tracy Avenue fire outlined by key informants, overall levels of satisfaction declined substantially from 2004. Fire risk perception did not decline in this period, but other concerns did decrease in intensity. Bivariate analysis of 2006 data showed that satisfaction with government land managers, a measure of confidence, had no relationship with risk perception of fire. There was, however, a significant negative relationship between satisfaction with government land managers and the perception of broader threats to ecological and community well-being. This relationship in the 2006 data was not found in the 2004 data. This suggests that perceived recreancy or lack of confidence in land managers may be more issue sensitive and temporally dynamic than previously operationalized. This finding supports the conclusions by Earle and Siegrist⁽³³⁾ that confidence may be more fragile than trust. The concept of relationship with land managers and its role in understanding risk perception is complex and in need of further exploration and operationalization across multiple cases in different contexts to validate these findings.

Longitudinal and mixed methods approaches provide insight into how communities respond to changes in environmental disturbances. Rural communities, such as Homer, Alaska, are situated in a unique interface between environment and society. Ecosystem disturbances may be more immediately experienced in such settings. Because of this, rural residents are an important population to consider when drawing conclusions about the human dimensions of ecosystem processes. Technical risk assessments focused on presumed immediate threats to property and safety such as fire without assessing the perceptions of local residents may miss broader risks that are important to local populations. A more inclusive risk assessment process incorporating local risk perceptions can highlight areas of agreement and disagreement between technical or scientific interpretations of risk and local sentiment. The goal of this broader process is a clearer articulation of priority issues as well as more sensitive issues needing careful negotiation to promote sound relationships between citizens, communities, and land management entities. Risk perceptions, often shared in communities in response to changing landscape conditions and evolving or "cascading" disturbances, are important to consider when making decisions about land use or natural resource management.

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