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Coping with Technological Disaster: An Application of the Conservation of Resources Model to the *Exxon Valdez* Oil Spill

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One hundred twenty-five commercial fishers in Cordova, Alaska, completed a mailed survey regarding current mental health functioning 6 years after the Exxon Valdez *oil spill. Economic and social impacts of the oil spill and coping and psychological functioning (modified Coping Strategies Scales, Symptom Checklist 90-R) were measured. Multiple regression was used to test the utility of the Conservation of Resources stress model for explaining observed psychological symptoms. Current symptoms of depression, anxiety, and Posttraumatic Stress Disorder were associated with conditions resource loss and avoidant coping strategies. The Conservation of Resources model provided a framework for explaining psychological impacts of the oil spill. Future research is needed to identify factors related to recovery.*

KEY WORDS: technological disasters; *Exxon Valdez* oil spill; Conservation of Resources model.

Research on the effects of disasters has consistently found significant impacts on mental health functioning, with depression, anxiety, and Posttraumatic Stress Disorder (PTSD) emerging as the most common psychological sequelae (for a review, see Green & Lindy, 1994). In addition, somatic complaints, relationship problems, and increased visits to mental health or medical facilities have also been reported. Green and Lindy (1994) contend that postdisaster mental health effects are most common within 2 years following a disaster. However, longer-term effects may also occur, with some individuals remaining symptomatic for as long as 14 years (Green et al., 1990; Green, 1996). Much of this research has focused

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on natural disasters, where mental health consequences generally dissipate within 2 years (Drabek, 1986; Green & Lindy, 1994). In contrast, technological disasters have been found to result in chronic impacts both to the individual and to the community in which the disaster has occurred (Baum, 1987; Baum & Fleming, 1993; Erikson, 1994; Farberow, 1985; Fleming & Baum, 1985; Kroll-Smith & Couch, 1993b).

The long-term, corrosive impacts of technological disasters have been documented in a number of studies. For example, Baum and Fleming's (1993) research on Three Mile Island identified increased somatic distress, anxiety, and depression among individuals for as long as 6 years following the accident. In addition, they found that biochemical changes, such as prolonged elevations in blood pressure and impaired immune system functioning, accompanied this pattern of chronic stress. Chronic mental health impacts have also been observed at toxic waste sites (Couch & Kroll-Smith, 1985; Kroll-Smith & Couch, 1993a) and for other instances of human-caused toxic contamination (Edelstein, 1988; Brown & Mikkelsen, 1989; Erikson, 1994).

Chronic impacts may result from factors immediately related to the causal agent of the disaster, as well as changes in the community observed at some later time. Given the human origins of technological disasters, relief and compensation strategies are often negotiated through litigation, thereby extending the time period for rehabilitation and recovery of victims (Picou & Rosebrook, 1993). Technological disasters, in particular, have been found to lead to a pattern of social deterioration referred to as the "corrosive community" (Freudenburg, 1997; Freudenburg & Jones, 1991; Kaniasty & Norris, 1993; Kroll-Smith & Couch, 1993a). Freudenburg and Jones (1991) suggest that this corrosive context includes community members struggling over where to place blame, authorities being evasive and unresponsive, and victims becoming suspicious and cynical. The present study examines the long-term consequences of a technological disaster (the *Exxon Valdez* oil spill) in which litigation has been protracted and the community has appeared to become corrosive. Effects are measured for a high-risk group (commercial fishers) and a theoretical model for understanding variations in functioning within this group is evaluated.

Conservation of Resources Model. Hobfoll's Conservation of Resources (COR) model of stress-response provides a theoretical framework for understanding the effects of both natural and technological disasters (1988, 1989). Hobfoll postulates that people are motivated to obtain, retain, and protect that which they value. Resources are defined as anything that people value or that enable them to obtain or protect that which they value. Resources can include possessions, personal characteristics, social systems (family and other interpersonal relationships), and financial resources and the ability to attain and retain the above resources. Hobfoll categorized resources into (1) objects (e.g., car, house, boat), (2) personal characteristics (e.g., self-esteem, self-concept, sense of mastery), (3) conditions (e.g., marriage, interpersonal relations), and (4) energies (e.g., credit, money, owed

favors). Hobfoll suggests that any event which results in actual or perceived loss of resources, or a lack of expected resource gain, will produce psychological stress. Whereas at times disasters result in substantial loss of possessions and economic resources, disasters may also generate resource loss through disruption of social systems, personal characteristics, and the ability to attain and retain resources (Freudenburg & Jones, 1991; Picou & Gill, 1996).

In recent years, a number of researchers have examined the utility of the COR model for predicting distress related to natural disasters. Freedy, Shaw, Jarrell, and Masters (1992) evaluated the effects of resource loss on psychological functioning following Hurricane Hugo in Charleston, South Carolina. While demographic factors (gender, marital status, and household income) and coping behaviors made significant contributions to levels of distress, they found that resource loss was the strongest predictor of psychological distress 8 weeks after the Hurricane.

The COR model was also tested among college students in Charleston 4 weeks following Hurricane Hugo (Kaiser, Sattler, Bellack, & Dersin, 1996). Kaiser and associates found that resource loss and depression accounted for the greatest portion of variance in psychological distress. Similarly, Freedy, Saladin, Kilpatrick, Resnick, and Saunders (1994) found that the COR model was also effective for predicting distress following the Sierra Madre earthquake (1991) in Los Angeles County. Again, resource loss was a significant predictor of psychological distress, even when controlling for demographic variables and trauma history.

These studies focused on applications of the COR model to short-term impacts of natural disasters. The present research expands this area of inquiry to include an evaluation of the COR model for explaining the chronic (6 years) impacts of a major technological disaster.

The Exxon Valdez *Oil Spill*. On March 24, 1989, the supertanker *Exxon Valdez* ran aground on Bligh Reef in Prince William Sound, Alaska. Approximately 42 million liters of oil was released into valuable commercial fishing grounds. While clearly a human caused technological disaster, the primary impact was perceived by many to be ecological, with few direct human consequences (Lord, 1997). This was the largest oil spill in North American history and ecological impacts continued to be identified 10 years after the event (Spies, Rice, Wolfe, & Wright, 1996; *Exxon Valdez* Oil Spill Trustee Council, 1999).

Commercial fishers in Prince William Sound experienced significant economic impacts in the two years immediately following the oil spill. Losses in revenue for fishers totaled over 155 million dollars during this time period (Cohen, 1995, 1997). Long-term economic losses continued from 1993 to 1997, with a total collapse of the commercial herring fishery for 5 years and a significant downturn in the pink salmon fishery (Schneider, 1993; Spies et al., 1996). These economic damages have not been mitigated through litigation, as legal appeals to a $5 billion jury award to commercial fishers continue to be reviewed by the courts 10 years following the spill.

Commercial fishing and resource harvests associated with subsistence culture are important social activities in Alaskan communities (Wolfe, 1983). These activities serve as sources of economic gain and are a part of how individuals define themselves and their quality of life. While the oil spill did not result in immediate loss of human life or damage to material possessions, it did result in economic damages and losses, as well as disruption of subsistence behavior in local communities (Cohen, 1997; Fall & Field, 1996). The importance of this loss for producing significant mental health effects was documented in a number of initial studies of the *Exxon Valdez* disaster.

One year after the spill, Palinkas, Russell, Downs, and Peterson (1992) studied Alaskan residents of 11 communities in the region directly exposed to the spill, with 2 communities in areas not directly exposed to the spill. Respondents completed a questionnaire which asked about exposure experiences, with exposure defined as prior use of coastal areas affected, work in cleanup activities, contact with oil spill-related activities, or effects of the spill on areas used for commercial and subsistence hunting, fishing, or gathering. Greater exposure to the spill was associated with higher levels of depression and a reported decline in social relationships.

Using the same sample, Palinkas, Peterson, Russell, and Downs (1993) examined rates of mental disorder and compared the mental health effects for individuals with high, low, and no exposure to the oil spill. One year following the spill, they found a prevalence rate of 20% for generalized anxiety disorder and 9% for PTSD, with 16.6% scoring in the clinical range on a depression scale. Greater exposure to the spill was associated with significantly higher rates of Generalized Anxiety Disorder and PTSD and high levels of depressive symptoms.

From 1989 to 1997, Picou and associates conducted a longitudinal study of an Alaskan community, Cordova, which was affected economically by the spill. In initial studies of spill consequences (Picou, Gill, Dyer, & Curry, 1992; Picou & Gill, 1996; Picou, Gill, & Cohen, 1997), effects of the spill were compared for residents of Cordova and residents of two control communities, Valdez and Petersburg, Alaska. Picou et al. (1992) identified higher levels of intrusive stress and avoidance behavior among members of the affected community compared to residents of Petersburg.

The purpose of the present study was to investigate the chronic effects of the oil spill by measuring symptom levels for anxiety, depression, and PTSD and social disruption among Alaskan fishers 6 years after the disaster. Specifically, the first objective was to assess the prevalence of symptoms in the community relative to normative data. It was hypothesized that local fishers affected by the oil spill would have significant levels of depressive symptoms, anxiety, and posttraumatic symptoms compared to normative data. A second objective of this research was to identify variables which were associated with stress-responses to the spill. The COR model was used as a theoretical framework for evaluating differential consequences of the oil spill. That is, it was hypothesized that levels of resource

loss would be positively correlated with levels of psychological distress. The third objective of this study involved the examination of coping strategies and psychological distress. It was hypothesized that the use of avoidant coping strategies, such as not talking about problems and trying not to think about problems, would be associated with increased symptoms of depression, anxiety, and posttraumatic stress. Finally, a comparison was made of the relative importance of resource loss versus coping strategies in predicting current psychological symptoms.

Method

Participants

Participants were recruited from fishers residing in Cordova, Alaska. Cordova is a small fishing community, with a population of 2500, located in southeastern Prince William Sound. The community is geographically isolated, accessible by boat or plane. The economy of Cordova is dominated by commercial fishing and Cordova fishers hold over 90% of the Prince William Sound fishery permits (Fried, 1994; Picou et al., 1992; Stratton, 1989). A list of members of the Cordova District Fishermen United (CDFU) in 1989 was obtained and these individuals were mailed an anonymous survey in the Fall of 1995. Five-hundred forty-one surveys were sent out, and of these, 95 were undeliverable or the individual was deceased. Of the 446 delivered surveys, 125 completed surveys were returned for a response rate of 28%.

Information on demographic characteristics of the respondents are summarized in Table 1. As is characteristic of the commercial fishing industry, the majority of respondents were male (86.4%) and were white (91.2%), with only a small percentage of women (13.6%) and Alaskan Natives (5.6%). Most of the respondents were married, had children, and had at least a high school education. The vast majority (88%) of the respondents owned their fishing vessels.

Measures

Demographic Data. Participants provided demographic data regarding gender, marital status, ethnicity, occupation, education, years in the community, household size, and household income.

Psychological Distress. Symptoms of anxiety, depression, and PTSD were assessed using the Symptom Checklist 90—Revised (SCL90-R; Derogatis, 1992). The SCL90-R is a 90-item self-report inventory designed to assess current psychological symptoms. Participants indicate on a scale from 0 to 4 the degree to which they have experienced each symptom over the past 2 weeks (0 = not at all; 4 = extremely). The complete measure was administered, however, this research

Table 1. Demographic Characteristics of Respondents (N = 125)

Variable	Frequency	Percentage
Gender		
Female	17	13.6
Male	108	86.4
Marital status		
Married	88	70.4
Not married	36	28.8
No response	1	0.8
Ethnicity		
White	114	91.2
Alaskan Native	7	5.6
Other	4	3.2
Occupation		
Owner	110	88.0
Skipper	6	4.8
Deckhand	1	0.8
Other	4	3.2
None	2	1.6
No response	2	1.6
Educational achievement		
Some high school	3	2.4
High school	36	28.8
Some college	53	42.4
College degree	16	12.8
Some graduate study	8	6.4
Master's degree	5	4.0
Professional degree	4	3.2
	Mean	Median
Other characteristics		
Years in community	32.8	25.0
Household size	2.8	2.0
Number of dependent children in home	1.0	0.0
1994 income	$52,000	$41,000

focused only on the subscale scores for Anxiety, Depression, and PTSD. The anxiety and depression subscales were derived by Derogatis (1992), whereas the PTSD symptoms were assessed using a subscale of the SCL90-R (Crime Related Post Traumatic Stress Disorder scale; CR-PTSD) which was devised by Saunders, Arata, and Kilpatrick (1990).

Scores on each scale were obtained by averaging the response to the items for each scale. Derogatis (1992) reported adequate test–retest and internal consistency reliability and concurrent and discriminant validity for the SCL90-R. The CR-PTSD scale has also been shown to have adequate internal consistency and concurrent validity (Arata, Saunders, & Kilpatrick, 1991; Saunders et al., 1990). Derogatis (1992) provides normative tables for a number of different populations. Nonpatient norms were used to establish a cutting score for asymptomatic versus symptomatic subjects on the Depression and Anxiety subscales.

Modified Coping Strategies Scale. Methods of coping were measured using a modified version of the Coping Strategies Scales (COSTS) developed by Beckham and Adams (1984). The original COSTS was modified in order to shorten the scale. Using a data set of 900 subjects from another study (Arata, Turnbow, & Shepard, 1996), the COSTS was modified by selecting eight items from each of three composite subscales which had the highest item–subscale correlations. The revised scales had correlations ranging from .86 to .94 with the original composite scales. Respondents were asked to complete the questionnaire based on activities they had engaged in to cope with the oil spill. Beginning with the stem, "Since the *Exxon Valdez* oil spill, I have," sample items included, "talked with friends or relatives about my problems," "felt angry but held it in," and "done something constructive." Each item was rated on a 4-point scale, where 1 = not at all, and 4 = often. Scales were scored by summing responses.

The internal consistency of the COSTS was evaluated with the current sample. The scale Emotional Expressiveness and Social Support Seeking had an alpha coefficient of .82, Emotional Containment and Passivity had an alpha coefficient of .83, and Coping Activity and Cognitive Restructuring had an alpha coefficient of .72.

Resource Loss. Indicators of resource loss were developed using items from the demographic/social data. Object resource loss was determined by four variables. Respondents answered a single question regarding whether they had been forced to sell possessions to compensate for losses due to the spill (yes/no). They also rated their perception of damage to Prince William Sound due to the oil spill (1 = no, 2 = too early to tell, 3 = yes). Respondents also gave a dollar estimate of the change in value of seining and gill fishing permits from 1989 to 1995.

Conditions resources are defined by Hobfoll as support mechanisms derived from life situations or roles in which people interact on a consistent basis, such as, job status, relationship networks, personal health, and community cohesion. Job status was assessed using a single question regarding whether the oil spill had an adverse effect on your work/occupation (yes/no). Community cohesion was similarly assessed with a single question regarding whether the spill had an adverse effect on the Cordova community (yes/no). Relationship networks were assessed using two questions regarding changes in relationships with relatives and nonrelatives. Respondents indicated on a 4-point scale whether relationships had (1) improved, (2) remained the same, (3) suffered but did not end, or (4) ended. Changes in physical health was assessed with one question rated on a 3-point scale (e.g., "Concerning your physical health, since the *Exxon Valdez* oil spill, do you perceive yourself as having (1) fewer emotional problems, (2) the same amount, or (3) more emotional problems).

Energies resources are defined as the time and money which people allocate to acquire and sustain resources. Loss of time was based on involvement in litigation regarding the oil spill (yes/no) and perceptions that litigation had been too long (yes/no). Loss of money was assessed based on the sum of reported financial

losses (or gains) for each of the years since the spill (1989–1994), compared to the immediately preceding year, including 1989. "Income loss spirals" were operationalized from income loss data. Hobfoll defines a loss spiral as occurring when initial resource loss produces stress which increases future loss, which in turn, increases future stress. Individuals who reported experiencing loss of income for 3 or more of the 6 years following the spill were coded as being in an income loss spiral, while all others were categorized as not experiencing a loss spiral. Additionally, resource investment without gain was assessed by asking individuals about second jobs taken to compensate for loss. Individuals who took second jobs, yet still reported an overall economic loss, were identified as making resource investments without significant resource gain. "Income loss spiral" and "resource investment without gain" were both dichotomous variables, with 1 indicating the individual was experiencing the indicator and 0 indicating the absence of that indicator.

Procedure

Participants received an anonymous survey by mail with a cover letter explaining the nature of the research and detailing the procedures that would be used in order to help ensure the confidentiality and anonymity of results. A Certificate of Confidentiality was obtained to ensure the confidentiality of respondents' participation in the study. A Certificate of Confidentiality authorizes the withholding of the names and other identifying characteristic of the participants and helps prevent the authors from being compelled to release this information in any legal proceedings (Department of Health, Education & Welfare, 1979). An addressed, stamped envelope was included for the participants to return the completed survey. Reminder postcards were mailed on two occasions to facilitate response rates.

Results

Demographic Variables

The relationship between the psychological and the demographic variables was examined. Pearson correlation coefficients were computed for continuous demographic variables (years in the community, years of education, 1994 household income), with ANOVA used for the categorical variables (gender, marital status). Ethnicity, occupation, and household size were not included due to the limited variability in these variables. Of the demographic variables examined, the only significant relationship obtained was between years of education and depression ($r = .18$, $p < .05$).

Psychological Symptoms

Respondents' scores on the anxiety, depression, and CR-PTSD subscales of the SCL90-R were examined in relation to normative data. Participants with a T score of 70 or greater on specific subscales were categorized as symptomatic. A T score of 70 suggests that less than 2% of a normal population obtained a score equal to or higher than the designated value and is a commonly used index of clinical significance (Kaplan & Saccuzzo, 1997). As standardized normative data are not available for the CR-PTSD scale, the cutoff of .89 suggested by Saunders et al. (1990) was used to differentiate symptomatic from asymptomatic individuals. As predicted, symptoms of depression and anxiety were commonly reported problems, with 23% of men and 13% of women indicating clinically significant levels of anxiety. Clinically significant levels of depressive symptoms were reported by 39% of men and 20% of women. Similarly, symptoms of PTSD were reported by many of the respondents. Using the .89 cutoff score identified by Saunders et al. (1990), 34% of the male fishers and 40% of the female fishers endorsed a high number of PTSD-related symptoms.

Resource Loss

The relationship between resource loss and psychological symptoms was initially evaluated using Pearson correlations (see Table 2). Of the four indicators of object resource loss (selling possessions, perceived damage to the Prince William Sound, and devaluation in seining and gill net permits), having had to sell possessions was the only variable which was significantly correlated with anxiety, depression, and PTSD, with correlations ranging from .23 to .26.

Of the five indicators of conditions resource loss, significantly higher levels of anxiety were correlated with perceived negative changes in relationships with family and nonrelatives and deterioration in physical health (correlations ranging from .28 to .38). Similarly, higher levels of depression were associated with changes in relationships with family and nonrelatives, negative impact of the spill on work, and perceived deterioration in physical health (correlations ranging from .22 to .43). Finally, greater symptoms of PTSD were associated with changes in relationships with family and nonrelatives and a perceived negative impact of the spill on work and health (correlations ranging from .19 to .40).

Of the five indicators of energies resources, involvement in an income loss spiral and investment without gain manifested the strongest associations with psychological symptoms. Symptoms of anxiety were significantly associated with these two variables (.27 and .31), while symptoms of depression and PTSD were both positively correlated with investment without gain (.21 and .22), involvement in a loss spiral (.24 and .24), and involvement in litigation (.18 and .19).

Table 2. Correlations Among Resource Loss Variables, Coping Measures, and Psychological Symptoms

Variable	*M* (*SD*)	Correlation		
		Anxiety	Depression	CR-PTSD
Object resources				
Sell possessions	0.43 (0.50)	.23**	.26**	.24**
Damage to PWS	2.77 (0.57)	.17	.09	.14
Sein permit devalued	$67,777 ($108,936)	.02	−.03	−.001
Gill net permit devalued	$70,965 ($87,842)	.03	.12	.09
Conditions resources				
Relations with relatives	2.35 (0.63)	.28**	.37**	.32**
Relations with nonrelatives	2.46 (0.55)	.38**	.43**	.40**
Physical health	1.55 (0.56)	.32**	.33**	.38**
Changes at work	0.97 (0.18)	.10	.22**	.19*
Changes in community	0.95 (0.21)	.04	.02	.05
Energies resources				
Loss spiral	0.74 (0.44)	.27**	.34**	.24**
Involved in litigation	0.97 (0.18)	.07	.18*	.19*
Litigation too long	0.97 (0.18)	.04	−.11	−.03
Economic loss	−$188,550 ($349,140)	−.01	−.02	.03
Investment without gain	0.47 (0.50)	.31**	.21**	.22**
Coping				
Emotional containment/ passivity	17.42 (9.98)	.47**	.57**	.55**
Emotional expressiveness/ social support seeking	10.53 (7.91)	.37**	.24**	.26**
Coping activity/cognitive restructuring	13.31 (7.81)	.20*	.20*	.21*

*$p < .05$.
**$p < .01$.

Coping Behaviors

An additional objective of the study was to examine the relationship between coping behaviors and spill-related psychological distress (Table 2). Coping activity, emotional containment, and emotional expressiveness were all significantly correlated with each of the psychological symptom variables (correlations ranging from .20 to .57).

Coping Behaviors and Resource Loss

Multivariate analyses were used to examine the cumulative effects of resource loss and coping behaviors on psychological symptoms (Table 3). Hierarchical multiple regression analyses were calculated using each of the psychological indicators (anxiety, depression, PTSD symptoms) as criteria. Because of the large number of variables, only those which were found to have significant correlations with

Table 3. Multiple Regression

Variable	*B*	*SE B*	*β*	R^2
Anxiety				
Step 1 (resource loss variables)				.296***
Relations with nonrelatives	2.92	1.22	.230*	
Changes in physical health	2.67	1.07	.223*	
Investment without gain	3.41	1.29	.248**	
Step 2 (resource loss & coping variables)				.416***
Relations with nonrelatives	2.46	1.16	.193*	
Investment without gain	3.18	1.21	.231**	
Emotional containment/passivity	.19	.07	.268**	
Emotional expressiveness/social Support seeking	.28	.09	.299***	
Depression				
Step 1 (demographic variables)				.060*
Years of education	1.96	.79	.245*	
Step 2 (demographic & resource loss variables)				.395***
Relations with nonrelatives	3.88	1.79	.206*	
Changes in physical health	5.15	1.57	.290***	
Step 3 (demographic, resource loss & coping variables)				.468***
Relations with nonrelatives	3.38	1.73	.180*	
Changes in physical health	3.90	1.58	.220**	
Emotional containment/passivity	.35	.10	.336***	
Posttraumatic stress symptoms (CR-PTSD)				
Step 1 (resource loss variables)				.371***
Relations with nonrelatives	.29	.11	.250*	
Changes in physical health	.40	.10	.363**	
Investment without gain	.24	.12	.190*	
Step 2 (resource loss & coping variables)				.457***
Relations with nonrelatives	.24	.11	.203*	
Changes in physical health	.31	.10	.281**	
Emotional containment/passivity	2.21	.01	.345***	

*$p < .05$.
**$p < .01$.
***$p < .001$.

each psychological variables were included as predictors for that psychological symptom. While prior research on the COR model typically includes demographic variables in the analysis (e.g., Freedy et al., 1994), years of education was the only demographic variable which had a significant relationship to any of the criteria in the bivariate analyses, thus, it was included in the regression for depression. Resource variables were entered before coping variables in order to determine the role of coping after considering the effects of resource loss on psychological symptoms.

Anxiety. Resource loss variables accounted for 30% of the variance in anxiety symptoms, with changes in physical health, changes in relations with nonrelatives, and investment without gain making significant contributions to the model. After adding the coping variables to the equation, the final model revealed that

investment without gain, changes in relations with nonrelatives, emotional containment, and emotional expressiveness predicted high levels of anxiety. These variables accounted for 42% of the variance in anxiety scores [$F(9,94) = 7.45$, $p < .0001$].

Depression. Years of education alone accounted for 6% of the variance in depression scores, however, this variable was no longer significant when resource loss variables were added to the model. When considering resource loss variables, changes in relations with nonrelatives and greater problems in health were significant predictors of symptoms of depression (39% of the variance). When the coping variables were added, changes in relations with nonrelatives, changes in health, and emotional containment were associated with increased depression. The final model accounted for 47% of the variance in depression scores [$F(11,87) = 6.96$, $p < .0001$].

PTSD Symptoms. Resource loss variables accounted for 37% of the variance in PTSD scores. Again, changes in relationships with nonrelatives, changes in physical health, and investment without gain made significant contributions to symptom levels. When the coping variables were added, changes in physical health, changes in relations with nonrelatives, and emotional containment remained in the final model. This final model accounted for 46% of the variance in CR-PTSD scores [$F(11,97) = 6.58$, $p < .001$].

Discussion

The objective of this research was an examination of the long-term psychological consequences of the *Exxon Valdez* oil spill for commercial fishers. It was hypothesized that fishers in the region of Alaska most impacted by the spill would have significant symptoms of depression, anxiety, and PTSD. The utility of the COR model for explaining chronic psychological symptoms existing 6 years after the spill was also evaluated. An analysis of the role of coping behaviors for enhancing or reducing the observed symptoms concluded the empirical analysis.

The hypothesis that the participants would have higher levels of depression, anxiety, and PTSD symptoms compared to a normative sample was supported. One-fifth of the fishers had clinically significant symptoms of anxiety and over one-third had significant symptoms of depression and/or PTSD. While the use of normative data implies that these rates are out of the ordinary for a normal population, the question can be raised regarding whether or not these symptoms can be attributed to the oil spill. The low response rate particularly leaves concern regarding a selection bias in our sample. Although we cannot rule out the threat, we think it is unlikely that selection bias explains the elevated distress observed in this sample. Findings from the 1995 survey may be compared to independent data, gathered in 1997. In the latter study, Picou, Johnson, and Gill (1997) compared psychological

distress levels among adult residents in Cordova with those of Petersburg, Alaska, a community not affected by the spill. Each 1997 sample was selected using random digit dial procedures and interviews were conducted via telephone. Comparisons of mean depression scores (using SCL90-R) were made between fishing subsamples from each population. Mean depression scores were higher among Cordova fishers ($p < .05$). This test provides independent verification that distress remained unusually elevated among Cordova fishermen 8 years after the spill. At the same time, it may be argued that the normative scores used for comparisons were not appropriate for this sample. Fishers in general, or Alaskans in general, may differ in their rates of psychiatric symptoms from the general population. While control data using the same measures were not available for this study, previous research with fishers from Cordova has demonstrated that increased symptoms of PTSD and general distress were significantly higher in this community than in neighboring communities that were not as severely impacted (Picou & Gill, 1996). Thus, our findings are consistent with the trends identified in previous research.

The second objective of this study was the evaluation of the Conservation of Resources Stress model for explaining chronic psychological impacts of the spill. To the degree that we were able to operationalize the types of resources described by Hobfoll, empirical support was found for the relationship between resource loss and the persistence of chronic psychological symptoms. In the bivariate analyses, significant relationships were obtained between resource loss and symptoms of anxiety, depression, and PTSD. Conditions resource loss was found to be associated with higher levels of all psychological symptoms. In particular, deterioration in relationships with others and deterioration in physical health were both repeatedly found to predict symptoms, in both the bivariate and the multivariate analyses. Relationships with relatives and changes in work were also associated with increased symptoms in the bivariate analyses.

Energies resource loss also had a significant relationship to chronic symptoms. In the bivariate analyses, being in an "income loss spiral" was associated with greater symptoms of depression, anxiety, and PTSD. Furthermore, "investment without gain" had a significant relationship to greater symptoms in both bivariate and multivariate analyses. Thus, individuals who experienced economic loss, despite taking on additional jobs to avoid loss, were more symptomatic than those who did not experience this phenomena. This finding was particularly interesting when contrasted with the fact that economic loss alone was not a significant predictor of psychological symptoms.

Of the object resources, selling possessions was the only variable found to be significantly related to psychological symptoms. Selling possessions was associated with greater symptoms of anxiety, depression, and PTSD in the bivariate analyses but failed to make a statistically significant contribution in the multivariate analyses when other types of resource loss and coping were considered. While defined as object loss, this would seem to be similar to loss due to investment

without gain; that is, individuals who were continually exhausting their efforts to compensate their losses were characterized by the most psychological symptoms.

In the bivariate analyses, each of the coping strategies was associated with higher levels of depression, anxiety, and posttraumatic symptoms. While greater distress was expected when using maladaptive coping strategies, such as emotional containment and passivity, it was expected that coping strategies which encouraged more adaptive thinking (coping activity and cognitive restructuring) would have been associated with decreased symptoms. Rather, the more distressed individuals appeared to be making use of a number of different coping strategies, some of which would seem to be opposite (emotional containment vs. emotional expressiveness). While all of the coping strategies were correlated with symptoms of distress, use of avoidant coping was found to be the best predictor of symptoms of depression, anxiety, and posttraumatic stress.

There are several interpretations relevant to our findings. First, the high rates of distress observed suggest that there have been significant long-term effects of the *Exxon Valdez* oil spill on the mental health of commercial fishers in this sample. While the limited sample makes it difficult to generalize these results, these findings are consistent with research suggesting that technological disasters produce chronic social disruption (Freudenburg & Jones, 1991). The application of the COR model helped to identify resource loss as a possible explanation for continued distress due to continuing loss of resources over time.

While there are a number of limitations to our study, the results provide empirical support for the significance of the COR framework for understanding the chronic psychological effects of disasters. Self-report data were relied on to assess losses and symptom levels and could be inaccurate or exaggerated. Norris and Kaniasty (1992), however, conducted a study of the reliability of delayed self-reports in disaster research in which they found that self-report data had high reliability. Because litigation is ongoing, there could also be concerns that individuals would be motivated to exaggerate symptoms. However, respondents were clearly informed that results were confidential and protected by a Certificate of Confidentiality obtained in order to ensure that the data would not be a part of any litigation. In fact, all criminal and civil litigation, except for appeals, had been completed at the time of our data collection. Consequently, there would have been little benefit for respondents to exaggerate symptoms for the purpose of litigation.

Another concern is whether the variables measured (social support, economic losses, etc.) were due to the oil spill and not some other factor. Certainly other events have happened since 1989 to members of this community and not all negative observations can be attributed to the oil spill. Respondents were specifically questioned regarding changes in relationships, finances, etc., that were "due to the spill," but it is possible that some of the changes could have resulted from other factors. While this may limit the ability of the study to clearly link psychological symptoms to the oil spill, the analysis supports Hobfoll's theory regarding the

relationships between losses and psychological functioning. Due to the use of a cross-sectional design, the direction of causation can only be guided by the COR framework and not empirically verified.

Overall, our results indicate that the effects of the *Exxon Valdez* oil spill on the fishers in this sample have been long-lasting and appear to have been influenced by the degree to which an individual found him- or herself involved in "investment without gain" and deteriorating social support and physical health. These findings are consistent with Kaniasty and Norris' "social support deterioration model" (1993), which argues that disasters have a direct effect on mental health, but that additionally, disasters result in deterioration in social support, which leads to further deterioration in mental health. This "corrosive community" model appeared to characterize commercial fishers' response to the spill (Freudenburg & Jones, 1991). The finding of a relationship between changes in health and symptom levels supports models of stress-related illness (Evans & Edgerton, 1990; Holen, 1991). In addition to supporting the "social deterioration model" and stress–illness models, the COR stress model provided an explanatory framework for understanding the process of resource loss and chronic psychological stress for victims of a major technological disaster. Our results also demonstrate the combined roles of resource loss and coping for predicting symptoms. Deterioration in relationships and avoidant coping can be seen as reciprocal processes which exacerbate each other. That is, as relationships deteriorate, one may use more avoidant coping, which in turn, has a negative effect on relationships. Continued research is needed to identify variables which might predict which individuals and groups are most vulnerable to long-term impairment, as well as what types of interventions would be beneficial in the short and long term to prevent and ameliorate the psychological consequences of technological disasters.

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References

Arata, C. M., Saunders, B. E., & Kilpatrick, D. G. (1991). Concurrent validity of a crime-related Post-Traumatic Stress Disorder scale for women within the Symptom Checklist-90—Revised. *Violence and Victims, 6*, 191–199.

Arata, C. M., Turnbow, M., & Shepard, H. (1996). *Coping with adult sexual assault: Attributions and prior abuse*. Poster presented at the Southeastern Psychological Association, Norfolk, VA.

Baum, A. (1987). Toxins, technology, and natural disaster. In G. R. Van Der Bos & B. K. Bryant (Eds.), *Cataclysms, crises and catastrophes: Psychology in action*. Washington, DC: American Psychological Association.

Baum, A., & Fleming, I. (1993). Implications of psychological research on stress and technological accidents. *American Psychologist, 48*, 665–672.

Beckham, E. E., & Adams, R. L. (1984). Coping behavior in depression: Report on a new scale. *Behaviour Research and Therapy, 22*, 71–75.

Brown, P., & Mikkelsen, E. J. (1989). *No safe place: Toxic waste leukemia and community action*. Berkeley: University of California Press.

Cohen, M. J. (1995). Technological disasters and natural resource assessment: An evaluation of the *Exxon Valdez* oil spill. *Land Economics, 71*, 65–82.

Cohen, M. J. (1997). Economic Impacts of the *Exxon Valdez* oil spill. In J. S. Picou, D. A. Gill, & M. J. Cohen (Eds.), *The Exxon Valdez disaster: Readings on a modern social problem* (pp. 133–163). Dubuque, IA: Kendall-Hunt.

Couch, S. R., & Kroll-Smith, J. S. (1985). The Chronic Technical Disaster: Toward a social scientific perspective. *Social Science Quarterly, 66*, 564–575.

Department of Health, Education and Welfare (1979). Protection of identity—Research subjects. *Federal Register, Part VII, 44*(66), 20382–20387.

Derogatis, L. R. (1992). *SCL90-R: Administration, scoring, & procedure manual—II*. Townson, MD: Clinical Psychometric Research.

Drabek, T. E. (1986). *Human system responses to disaster: An inventory of sociological findings*. New York: Springer-Verlag.

Edelstein, M. R. (1988). *Contaminated communities: The social and psychological impacts of residential toxic exposure*. Boulder, CO: Westview.

Erikson, K. T. (1994). *A new species of trouble*. New York: W. W. Norton.

Evans, P. D., & Edgerton, N. (1990). Life events as predictors of the common cold. *British Journal of Medical Psychology, 64*, 35–44.

Exxon Valdez oil spill Trustee Council (1999). *Recovery of injured resources and services: 1999 update*. Anchorage: State of Alaska and National Oceanic and Atmospheric Administration.

Farberow, N. L. (1985). Mental health aspects of disaster in smaller communities. *American Journal of Social Psychiatry, 4*, 43–55.

Fall, J. A., & Field, L. J. (1996). Subsistence use of fish and wildlife before and after the *Exxon Valdez* oil spill. *American Fisheries Society Symposium, 18*, 819–836.

Fleming, I., & Baum, A. (1985). The role of prevention in technological catastrophe. *Prevention in Human Services, 4*, 139–152.

Freedy, J. R., Shaw, D. L., Jarrell, M. P., & Masters, C. R. (1992). Towards an understanding of the psychological impact of natural disasters: An application of the Conservation of Resources Stress model. *Journal of Traumatic Stress, 5*, 441–455.

Freedy, J. R., Saladin, M. E., Kilpatrick, D. G., Resnick, H. S., & Saunders, B. E. (1994). Understanding acute psychological distress following natural disaster. *Journal of Traumatic Stress, 7*, 257–273.

Freudenberg, W. R. (1997). Contamination, corrosion, and the social order: An overview. *Current Sociology, 45*, 19–39.

Freudenburg, W. R., & Jones, T. R. (1991). Attitudes and stress in the presence of technological risks: Towards a sociological perspective. *Social Forces, 69*, 1143–1168.

Fried, N. (1994). A trends profile—The city of Cordova. *Alaska Economic Trends, March*, 1–4.

Green, B. L. (1996). Traumatic stress and disaster: Mental health effects and factors influencing adaptation. In F. L. Mak & C. C. Nadelson (Eds.), *International review of psychiatry, Vol. 2*. Washington, DC: American Psychiatric Press.

Green, B. L., & Lindy, J. D. (1994). Post-traumatic stress disorder in victims of disasters. *Psychiatric Clinics of North America, 17*, 301–309.

Green, B. L., Lindy, J. D., Grace, M. C., Gleser, G. C., Leonard, A. C., Korol, M., & Winget, C. (1990). Buffalo Creek survivors in the second decade: Stability of stress symptoms. *American Journal of Orthopsychiatry, 60*, 43–54.

Hobfoll, S. E. (1988). *The ecology of stress*. Washington, DC: Hemisphere.

Hobfoll, S. E. (1989). Conservation of Resources: A new attempt at conceptualizing stress. *American Journal of Community Psychology, 9*, 91–103.

Holen, A. (1991). A longitudinal study of the occurrence and persistence of post-traumatic health problems in disaster survivors. *Stress Medicine, 7*, 11–17.

Kaiser, C. F., Sattler, D. N., Bellack, D. R., & Dersin, J. (1996). A Conservation of Resources approach to a natural disaster: Sense of coherence and psychological distress. *Journal of Social Behavior and Personality, 11*, 459–476.

Kaniasty, K., & Norris, F. H. (1993). A test of the Social Support Deterioration Model in the context of natural disaster. *Journal of Personality and Social Psychology, 64*, 395–408.

Kaplan, R. M., & Saccuzzo, D. P. (1997). *Psychological testing: Principles, applications, and issues* (4th ed.). New York: Brooks/Cole.

Kroll-Smith, S., & Couch, S. R. (1993a). Symbols, ecology, and contamination: Case studies in the ecological-symbolic approach to disaster. *Research in Social Problems and Public Policy, 5*, 47–73.

Kroll-Smith, S., & Couch, S. R. (1993b). Technological hazards: Social responses as traumatic stressors. In J. P. Wilson & B. Raphael (Eds.), *International handbook of traumatic stress syndromes*. New York: Plenum Press.

Lord, N. (1997). Oil in the sea: Initial biological impacts of the *Exxon Valdez* oil spill. In J. S. Picou, D. A. Gill, & M. J. Cohen (Eds.), *The Exxon Valdez disaster: Readings on a modern social Problem* (pp. 95–109). Dubuque, IA: Kendall-Hunt.

Norris, F. H., & Kaniasty, K. (1992). Reliability of delayed self-reports in disaster research. *Journal of Traumatic Stress, 5*, 575–588.

Palinkas, L. A., Russell, J., Downs, M. A., & Peterson, J. S. (1992). Ethnic differences in stress, coping, and depressive symptoms after the *Exxon Valdez* oil spill. *Journal of Nervous and Mental Disease, 180*, 287–295.

Palinkas, L. A., Peterson, J. S., Russell, J., & Downs, M. A. (1993). Community patterns of psychiatric disorders after the *Exxon Valdez* oil spill. *American Journal of Psychiatry, 150*, 1517–1523.

Picou, J. S., & Gill, D. A. (1996). The *Exxon Valdez* oil spill and chronic psychological stress. *American Fisheries Society Symposium, 18*, 879–893.

Picou, J. S., & Rosebrook, D. R. (1993). Technological accident, community class action litigation, and scientific damage assessment: A case study of court-ordered research. *Sociological Spectrum, 13*, 117–138.

Picou, J. S., Gill, D. A., Dyer, C. L., & Curry, E. W. (1992). Stress and disruption in an Alaskan fishing community: Initial and continuing impacts of the *Exxon Valdez* oil spill. *Industrial Crisis Quarterly, 6*, 235–257.

Picou, J. S., Gill, D. A., & Cohen, M. J. (1997). The *Exxon Valdez* disaster: Readings on a modern social problem. Dubuque, IA: Kendall-Hunt.

Picou, J. S., Johnson, D. G., & Gill, D. A. (1997). *Mitigating the chronic impacts of localized environmental degradation: A case study of the Exxon Valdez oil spill*. Final report to the Prince William Sound Regional Citizens Advisory Council, Anchorage, AK.

Saunders, B. E., Arata, C. M., & Kilpatrick, D. G. (1990). Development of a crime-related Post-Traumatic Stress Disorder scale for women within the Symptom Checklist-90—Revised. *Journal of Traumatic Stress, 3*, 439–448.

Schneider, D. (1993). Alaska's unsound salmon fishery. *Pacific Fishing, 42*(June), 36–39.

Spies, R. B., Rice, S. D., Wolfe, D. A., & Wright, B. A. (1996). The effects of the *Exxon Valdez* oil spill on the Alaskan environment. *American Fisheries Society Symposium, 18*, 1–16.

Stratton, L. (1989). *Resource use in Cordova: A coastal community of southcentral Alaska*. Alaska Department of Fish and Game, Department of Subsistence, Technical Paper No. 153. Anchorage, Dec.

Wolfe, R. J. (1983). Understanding resource uses in Alaskan socioeconomic systems. In R. J. Wolfe & L. J. Ellanna (Eds.), *Resource use and socioeconomic systems: Case studies in fishing and hunting in Alaskan communities* (pp. 248–274). Juneau: Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 61.