

Probability of Containment by Medium Initial Attack Crews in the Boreal Spruce Fuel Type

K.G. Hirsch, D.L. Martell, and P.N. Corey

Introduction

Quantitative information concerning the effectiveness of initial attack (IA) crews is required for many fire management activities including strategic and daily planning, initial attack dispatching, and the selection of fire suppression tactics. Addressing this issue has proven to be extremely difficult in the past (Hirsch and Martell 1996); however, an expert judgement study (Hirsch et al. 1998) has resulted in the development of an empirical relationship between the probability of containment (POC) by a medium (5- to 7-person) initial attack crew, fire size, and fire intensity. The primary purpose of this poster is to illustrate IA crew capability with and without bucketing support for application in operational fire management activities such as preparedness planning, initial attack dispatching, and the selection of suppression tactics.

Study Overview

Expert judgement elicitation can be an effective technique for collecting data when alternative approaches are not feasible or practical (e.g., too expensive, too time consuming, logistically onerous, or potentially dangerous). Expert judgement data can be considered much more than a simple guess if it is acquired in a manner that attempts to minimize the potential for bias (Meyer and Booker 1991). In this study, data was acquired using structured, one-on-one interviews with 34 experienced initial attack crew leaders from 4 Canadian forest fire management agencies (Alberta, Manitoba, Ontario (Northwest Region), and the Northwest Territories). During the interviews, 35 initial attack scenarios, consisting of combinations of 5 fire intensities (165, 1500, 2500, 6500, and 10000 kW/m) and 7 fire sizes (0.1, 0.2, 0.5, 1.0, 2.0, 4.0, and 5.0 ha) were presented to each crew leader using videos, diagrams, and photographs. For every scenario each expert was asked to estimate the probability of containment (i.e., number of times out of 10 trials) that the fire could be contained and to describe the suppression tactics that would be used in each situation. Data for 6 ancillary variables pertaining to the background and experience of the experts was also collected (i.e., number of years of firefighting experience; number of initial attacks; percentage of surface, intermittent crown, and continuous crown fires attacked; and employing agency).

A total of 1190 POC estimates were analyzed using descriptive statistics and response curve analysis (a form of regression analysis). The results showed that fire size, fire intensity, and the interaction between size and intensity significantly influenced the POC estimates. Of the ancillary variables, only the experts' employing agency had a significant impact on the results. Based on this analysis, two probability or containment models were developed: one for a medium crew with bucketing support (based on the Alberta, Manitoba, and Northwest Territories data) and one for a medium crew with no bucketing support (based on the data from the Ontario experts whose estimates did not consider bucketing because it is rarely used in northwestern Ontario).

Assumptions, Features, and Limitations

Although a significant relationship exists between the probability of containment, fire size and fire intensity, there are many other factors that could influence the effectiveness of an IA crew. Therefore, the graphs presented are meant to serve as general guidelines for estimating the capability of a medium IA crew. Users are encouraged to become familiar with the key features of the underlying model, its limitations, and the assumptions upon which the expert judgements were made. This knowledge will facilitate the appropriate application and interpretation of the information.

Assumptions

- Probability of containment — Refers to the likelihood that one (and only one) 5- to 7-person initial attack crew will stop the forward spread or growth of a fire within a reasonable period of time (i.e., 3–5h).
- Fuel type — Boreal Spruce (C-2) fuel type. Fuels are homogeneous and continuous in all directions.
- Water availability — Readily available. Power pump, within 150 m (500 ft) of the head of the fire; backpack pump, within a few metres of the fire's perimeter; bucketing helicopter, 1 min turnaround time with a 1350:l (300 gal) bucket.
- Weather conditions — No sudden or extreme changes over the initial attack period.
- Crew/firefighter characteristics — Five to seven crew members who are well-trained, rested, and have an average amount of experience.

Features

- The model focuses on the fire environment characteristics and suppression techniques common to the boreal forest of western and central Canada.
- The probability of containment model is based on subjective, quantitative data acquired from experienced, professional crew leaders who carry out initial attack activities on a daily basis.
- The model is probabilistic and therefore captures some (but not all) of the uncertainty associated with initial attack activities. Common factors that were incorporated into the expert's judgements included crew motivation, physical conditioning, influence of spotting, direct and indirect benefits of bucketing, and the possibility of equipment failure.

Limitations

- The probability of containment model was developed for a specific set of conditions and may not be directly applicable to other types of fire suppression situations (e.g., different types of fuels or crews).
- Due to the nature of the statistical modeling techniques, the model slightly over-predicts the probability of containment in the lower end of the continuous crowning phase (i.e., at about 6500 kW/m).
- The model is based on subjective opinion and would benefit from data obtained in actual initial attack situations with conditions similar to those used in this study.

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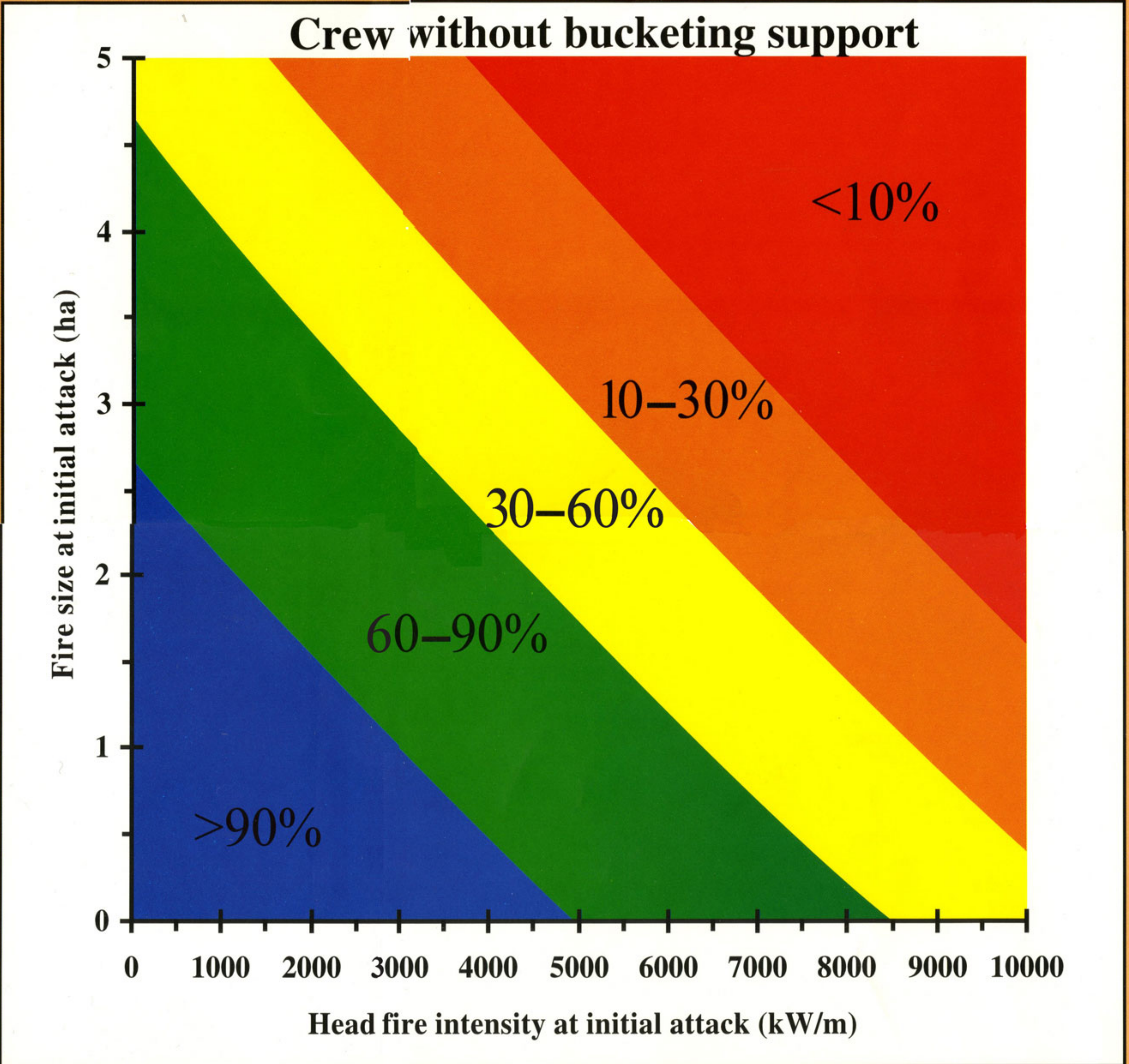
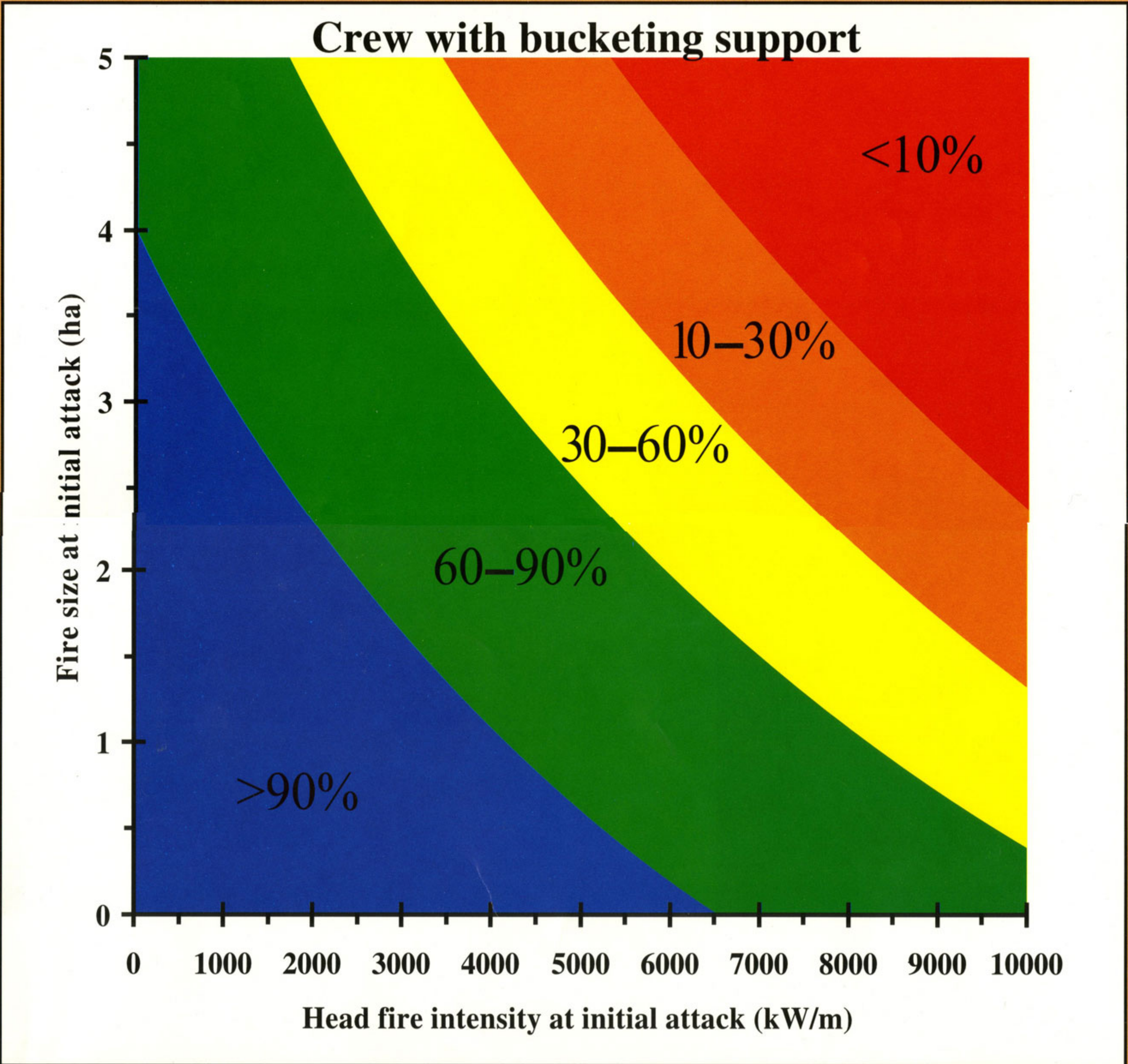
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Surface fire
(165 kW/m)



Intermittent crown fire
(1500 kW/m)



Intermittent crown fire
(2500 kW/m)



Intermittent crown fire
(6500 kW/m)



Continuous crown fire
(10000 kW/m)