Abstract—We calculated the power of visual length estimates by novice and experienced scientific SCUBA divers and estimates generated by a stereo-video system to detect changes in the mean length of three common species of reef fish from New Zealand. Length estimates from a stereo-video system had much greater power for blue cod (mean length=33.1 cm., range 19.5–50.1 cm.) and snapper (mean length=31.7 cm., range 23–71 cm.). For a third species, red cod (mean length=42.5 cm., range 13–74 cm.), the statistical power of diver and stereo-video estimates was much less for an equivalent number of samples owing to the greater variation in the true mean length of red cod recorded at different sites. At 90% power, a stereo-video system detected a 15% (~5-cm) change in the mean length of blue cod with 63% less samples (10) than those required by the experienced scientific divers (27). Novice scientific divers required 28 samples.

Improving the statistical power of length estimates of reef fish: a comparison of estimates determined visually by divers with estimates produced by a stereo-video system

Euan Harvey

Department of Marine Science
University of Otago
304 Castle Street
Dunedin, New Zealand
Present address: Department of Botany
University of Western Australia
Western Australia 6907, Australia
E-mail address: euanh@cyllene.uwa.edu.au

David Fletcher

Department of Mathematics and Statistics
University of Otago
539 Castle Street
Dunedin, New Zealand

Mark Shortis

Department of Geomatics
University of Melbourne
Parkville, Melbourne
Victoria 3052, Australia

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Visual censuses of reef fish have been used to monitor fish communities as indicators of environmental degradation (Hourigan et al., 1988; Fausch et al., 1990) and as a fisheries management tool for assessing the condition of reef fish stocks (Ault et al., 1998). Ault et al. (1998) used data on the average length of a fish stock as an index of fishing effects. Information on the length frequency or mean length of a fish population when linked with even a rudimentary knowledge of the biology of the species may allow estimates of recruitment to the adult population, fishing intensity, and rates of recovery from fishing (McCormick and Choat, 1987).

Environmental surveys commonly use SCUBA divers to count and visually estimate the length of individual reef fish (Jones and Chase, 1975; Harmelin-Vivien and Bouchon-Navaro, 1981; Bellwood and Alcala, 1988; Samoilys, 1989; English et al., 1994). These visual censuses have many advantages in comparison with other sampling techniques: they are quantitative, quick, nondestructive and repeatable (English et al., 1994). Visual census techniques have been widely adopted and are used to monitor changes in the relative abundance or mean length of reef fish within marine protected areas (Bell, 1983; McCormick and Choat, 1987; Alcala, 1988; Cole et al., 1990; Francour, 1991, 1994; Russ and Acala, 1996) and as a tool for assessing the standing stock or biomass of individual species of reef fish (Craik, 1981; Russ, 1985; Medley et al., 1993; Polunin and Roberts, 1993; Hart et al., 1996). Biomass is estimated from the relationship between length and the weight of an individual fish of a certain species (Kulbicki, 1989; Kulbicki et al.,1993). However, the question not yet addressed is how useful are data from visual length estimates for detecting changes in the mean length or length frequency of a population of reef fish?

The advantages of assessing the statistical power of environmental monitoring programs has been discussed by