



Full length article

Evaluation of the čibu-d, traditional halibut hook of the Makah Tribe, for reducing catch of non-target species in recreational Pacific halibut fisheries



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ABSTRACT

On the US west coast, the incidental mortality of non-target fish species in the recreational fishery for Pacific halibut (*Hippoglossus stenolepis*; hereafter halibut) is a management concern. One potential approach to reducing non-target fish mortality is to use fishing hooks that more effectively target halibut. In this study, we evaluated the feasibility and effectiveness of using the čibu-d, a halibut hook traditionally used by the Makah Tribe, for recreational halibut fishing. The Makah Tribe ethnographic record indicates that the čibu-d was selective for moderately sized halibut with little or no catch of other species. We tested the fishing performance of the čibu-d as compared to paired circle hooks (size 8/0) commonly used for recreational fishing using a charter-boat and volunteer anglers. Catch rates of halibut and non-target species, relative (target to non-target) catch ratios, and size selectivity of halibut caught by the two types of hooks were evaluated. Interviews with anglers were also conducted to assess angler opinions on use of the čibu-d. Catch rates of both halibut and non-target species were significantly less for the čibu-d than for circle hooks. Although catch rates were lower for čibu-d, they were 7.4 times more likely to catch a halibut than a non-target species compared to circle hooks. The catch ratio result, along with the positive response of anglers to using the čibu-d, indicate the čibu-d is a feasible hook type alternative for reducing catch of non-target fish species during recreational halibut fisheries particularly in areas where catch of non-target species is a conservation concern.

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1. Introduction

Impacts of recreational fisheries have often been overlooked due to the disparity in the impacts between commercial fishermen and recreational anglers and logistical difficulties of monitoring and evaluating impacts of recreational fisheries (Cooke and Cowx, 2004, 2006; Lewin et al., 2006). Recent studies have found that recreational fisheries can have a variety of direct and indirect impacts (Schroeder and Love, 2002; Cooke and Cowx, 2006; Lewin et al., 2006). It has also been shown that catch-and-release and release of unwanted or prohibited fish contributes to the problem because hooked fish experience increased mortality and reduced fitness (Wilson et al., 2014). Recent research and education programs have resulted in reduced mortality of released fish during

recreational fisheries (Cooke and Suski, 2004; Bartholomew and Bohnsack, 2005), however the best measure to prevent mortality of unwanted fish is to not hook them. This study focused on gear modifications to reduce bycatch in recreational Pacific halibut (*Hippoglossus stenolepis*; hereafter halibut) fisheries in the International Pacific Halibut Commission (IPHC) regulatory area 2A (Washington, Oregon and California). In 2014, the recreational fishery was allocated 44% of the total allowed quota within regulatory area 2A (Gilroy et al., 2015). The popularity of recreational halibut fishing in this area has increased rapidly since the 1970s to the point that extremely short fishing seasons (i.e. the season was three days in Area 4 of Washington in 2015) and quotas are now necessary to prevent overfishing (Dykstra, 2015). In spite of their short duration, there are still management concerns due to bycatch of non-target fish species. Some areas are closed to all bottom fishing, including halibut fishing, to prevent catch of rockfish (CDFG, 2015; ODFW, 2015; WDFW, 2015). In some regulatory areas, some or all species

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other than halibut must be discarded during halibut fishing (ODFW, 2015; WDFW, 2015).

The non-target species of greatest concern for management in area 2A are yelloweye rockfish (*Sebastes ruberrimus*) and canary rockfish (*Sebastes pinniger*) (NOAA, 2012). Rockfish (*Sebastes* sp.) are generally long-lived, reproduce late in life, and when reeled up from depth experience barotrauma which leads to high rates of post-release mortality (Parker et al., 2000). Thus, management measures to prohibit retention do not ameliorate fishing impacts to rockfish (Hannah et al., 2008). Recent research has led to the development of devices to descend rockfish to depth for release which have been shown to substantially increase survival relative to releasing rockfish at the surface (Hochhalter and Reed, 2011), although benefits of deepwater release have not been equal for all rockfish (Hannah et al., 2014). Rockfish are not the only non-target species caught during recreational halibut fishing that are sensitive to over-fishing. Spiny dogfish also are long-lived, have delayed maturation (Saunders and McFarlane, 1993), have had populations collapse due to fishing pressure (Musick et al., 2000), and are commonly caught during recreational halibut fisheries.

The primary hook type used to catch halibut changed from 'J' hooks to circle hooks in the early 1980s primarily because the circle hook increased the retention of halibut (Leaman et al., 2012). The use of circle hooks also improved the ability of anglers to release halibut and other species with reduced mortality or trauma because the circle hook most commonly hooks the lip of a fish whereas the "J" hook often hooks deeper in the mouth (Cooke and Suski, 2004; Bartholomew and Bohnsack, 2005). Even with the use of circle hooks and the implementation of closed areas, the catch rate of non-target species like rockfish is still a concern (Kaimmer and Wischniowski, 2013). Kaimmer and Wischniowski (2013) tested the use of a circle hook with a thin wire across the gape of the hook to prevent rockfish catch while fishing for halibut, but they did not find a significant reduction in the catch of large rockfish. The authors concluded that the similarity of hooking behavior of large rockfish and halibut negates the likelihood that a hook could be modified to be selective for halibut but not for large rockfish (Kaimmer and Wischniowski, 2013). However, a hook that targets halibut and prevents the catch of rockfish and other non-target species may have been developed thousands of years ago.

Tribes of the Pacific Northwest have fished for halibut since time immemorial giving them ample opportunity to develop hook designs to specifically target halibut while not catching non-target species. Fishermen of the Makah Tribe were said to be singular in their purpose of catching specific species of fish (Waterman undated), so much so that the Makah language does not have a generic word for fishing but rather has fishing terms that include the target species name (Swan, 1870). A special hook, called the čibu-d by the Makah Tribe, was made to target halibut (Fig. 1; Swan, 1870; Waterman undated; Stewart, 1977). The čibu-d is a 'U' shaped hook that was used by tribes from northern Washington through southern Alaska. North of Vancouver Island, the čibu-d frame was made from the elbow of a branch or by lashing two pieces of wood together; from Vancouver Island southward the čibu-d frame was made from steam bending a single piece of hemlock, true fir, or yew (Friedman, 1975; Stewart, 1977). The barb of the čibu-d was historically made from bone, antler, or wood (Waterman undated; Stewart, 1977). As metal became available to tribes (~1800s) it was used for making both the frame and the barb of the čibu-d (Stewart, 1977). The southern čibu-d was fished with a hand-line that was attached to a spreader bar which suspended two čibu-d one meter apart roughly 60 cm above the bottom (Stewart, 1977). Northern čibu-d were also fished with a hand-line that was attached with a slip knot to a sinker, with the čibu-d floating above the sinker off the bottom (Stewart, 1977).

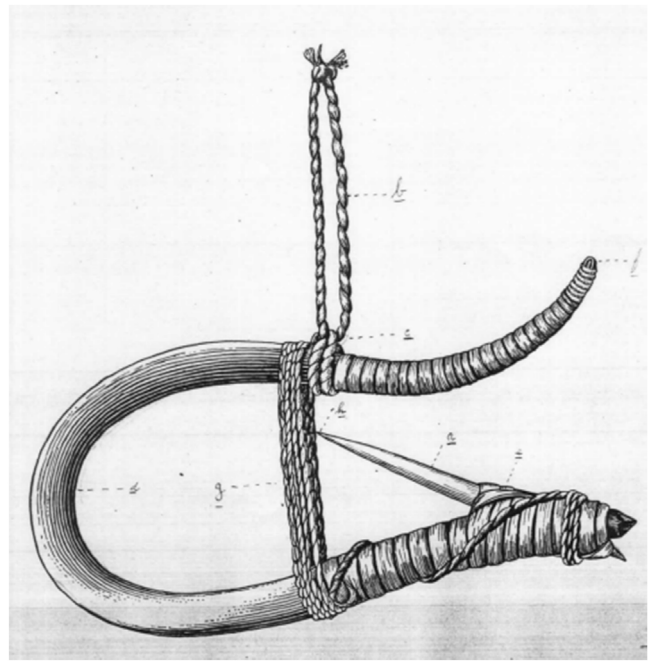


Fig. 1. The traditional čibu-d of the Makah Tribe made of hemlock or true fir as depicted in Waterman (undated) with a line wrapped around the čibu-d used for tying the bait in place.

The čibu-d was reported to only, or at least very selectively, catch halibut (Swan, 1870; Waterman undated; Stewart, 1977). In addition, the hook was reported to selectively catch halibut around 11.3–13.6 kg (Waterman undated; Huelsbeck pers. comm.) at a time when the average halibut was reported to be 27.2 kg (Anonymous, 1858). The size selectivity of the čibu-d was made possible by the length of the barb preventing small halibut from biting the hook while the distance of the gap between the barb tip and the frame of the čibu-d prevented the lip of a large halibut from passing over (Waterman undated). If čibu-d are as selective for species and size of halibut caught as the ethnographic and archeological record suggest, then the hook could be a very useful tool for fisheries management for minimizing impacts to non-target species (Hall et al., 2000; Werner et al., 2006). The benefit of the size selectivity of the čibu-d would be that large halibut, which are predominately female (Loher and Seitz, 2008), would stay in the population to reproduce (Birkeland and Dayton, 2005).

In this study, we tested the relative performance of čibu-d in a recreational halibut fishery in Washington. Our primary hypotheses were that 1) the čibu-d would have similar halibut catch to the commonly used circle hooks, 2) the čibu-d would have significantly lower catch of non-target (bycatch) species, and 3) the čibu-d would catch a more selective size range of halibut than circle hooks. Noting that gear modifications are only effective if anglers are willing to use them (Campbell and Cornwell, 2008), we also interviewed the volunteer anglers who participated in this study to determine if anglers would desire to use the čibu-d in future halibut recreational fishing.

2. Materials and methods

2.1. Construction of čibu-d

The first step in making the čibu-d was to grind one end of a 0.625 cm (0.25 in.) diameter brass rod from roughly 6.5 cm (2.5 in.) gradually out to a narrowing tip. The rod was then cut at 30.5 cm (12 in.) of length. The brass rod was then hand-bent into the frame

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