To the 'Friends' with thanks Jane

The effects of sea otters (*Enhydra lutris*) on abalone (*Haliotis* spp.) populations

Jane Watson

Abstract: Historically sea otters (*Enhydra lutris*) were common in coastal regions of the North Pacific. They were hunted to near extinction from the mid-1700s until 1911 but were reintroduced to portions of their historic range in the 1960s and 1970s. Sea otters prey on invertebrates and limit the size and abundance of their prey. Extirpation of the sea otter eliminated its role as a predator and resulted in dense populations of invertebrates, including abalone (*Haliotis* spp.). Abundant abalone populations, along with developing markets, resulted in the growth of commercial abalone fisheries. However, sea otters and abalone fisheries are mutually exclusive. In areas occupied by otters, abalone occur at low but stable densities and are restricted to crevices. The co-existence of otters and abalone appears to depend on habitat type and the life history characteristics of abalone. Even in the absence of sea otters, commercial abalone fisheries along the west coast of North America have collapsed. This paper reviews the status of sea otter populations, the effects of sea otters on abalone, and the history of abalone fisheries within the historic range of sea otters.

Résumé : Par le passé, les loutres de mer (*Enhydra lutris*) étaient nombreuses dans les régions côtières du Pacifique Nord. Entre le milieu du XVIII[e] siècle et 1911, elles ont presque été chassées jusqu'à l'extinction, mais on les a réintroduites dans des parties de leur aire de répartition d'origine dans les années 60 et 70. La loutre de mer se nourrit d'invertébrés et limite ainsi la taille et l'abondance de ses proies. Sa disparition avait éliminé son rôle de prédateur et provoqué l'augmentation de la densité des populations d'invertébrés, dont les ormeaux (*Haliotis* spp.). L'abondance des populations d'ormeaux, ainsi que les marchés en développement, ont entraîné la croissance de la pêche commerciale de cette espèce. Toutefois, les loutres de mer et les ormeaux sont mutuellement exclusifs. Dans les endroits occupés par les loutres, les densités d'ormeaux sont faibles mais stables, et leur présence se limite aux fissures des rochers. La coexistence des loutres et des ormeaux semble dépendre du type d'habitat et des caractéristiques historiques du mode de vie des ormeaux. Même en l'absence des loutres de mer, la pêche commerciale à l'ormeau sur la côte Ouest de l'Amérique du Nord a chuté. La présente étude revoit l'état des populations de loutres de mer, les effets qu'elles ont sur les ormeaux et l'histoire de la pêche à l'ormeau à l'intérieur de l'aire de répartition historique des loutres de mer.

[Traduit par la Rédaction]

Introduction

The sea otter (*Enhydra lutris*) is a small marine carnivore, which preys upon benthic invertebrates and, in some cases, slow-moving demersal fishes (Estes and Palmisano 1974; Estes et al. 1982). Sea otters once were distributed from the Kurile Islands along coastal areas of the North Pacific to cold, upwelled regions of Baja California, Mexico (Kenyon 1969). Although the exact size of the otter population before the arrival of Europeans is unknown, estimates range from 150 000 to 300 000 animals (Kenyon 1969; Johnson 1982). Midden remains indicate that aboriginal people exploited sea otters and likely reduced otter abundance around village sites (Simenstad et al. 1978; Walker 1982). Large-scale, commercial exploitation of sea otters off North America began in the mid-1700s. This intense, maritime fur trade, which lasted until sea otters were protected in 1911, may have reduced the sea otter population to fewer than 1000 individuals located in 12 remnant populations (Kenyon 1969).

In the absence of exploitation, sea otter populations have grown and spread throughout much of their historic range (Estes 1990). Expansion of the sea otter's range was aided in the late 1960s and 1970s by a series of reintroductions. Sea otters were captured from Amchitka Island and Prince William Sound and were translocated to southeast Alaska, British Columbia, Washington State, and Oregon. With the exception of the reintroduction to Oregon, all of these translocation efforts were successful and resulted in well-established sea otter populations (Jameson et al. 1982). In 1987, sea otters were captured from the central coast of California and translocated to San Nicolas Island, one of the eight Channel Islands, located in the southern California Bight (Benz 1996).

Before the mid-1800s sea otters probably limited the size, abundance, and distribution of many invertebrate populations (Johnson 1982; Estes and VanBlaricom 1985; Watson and Smith 1996). Overexploitation of sea otters eliminated their role as predators and, with reduced predation, dense populations of large invertebrates resulted. These abundant invertebrate populations, along with developing markets, contributed to the growth of commercial and recreational

J. Watson. Malaspina University-College, 900 Fifth St., Nanaimo, BC V9R 5S5, Canada, and Fisheries Centre, 2204 Main Mall, University of British Columbia, Vancouver, BC V6T 1Z4, Canada.

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abalone recruitment and allow abalone to remain in crevice refugia where they are not accessible to sea otters. Thus, in the absence of human exploitation, small patchy populations of abalone may occur in areas where sea otters forage (Pollard 1992).

The present limited geographic range of sea otters means that otters cannot be held responsible for the collapse of the abalone fishery in southern California, British Columbia, or southeast Alaska (Sloan and Breen 1988; Davis et al. 1996). In fact, in many areas where harvest bans have been implemented, abalone stocks continue to decline, apparently as a result of increased poaching due to the enhanced market value brought about by severe harvest restrictions (see papers in Campbell 2000*a*).

The conflict between sea otters and abalone harvesters seems inevitable. However, by examining abalone populations in areas exposed to sea otter foraging alone, biologists may be able to identify the life-history characteristics that permit abalone and their predators to co-exist. These insights may be important to fisheries managers attempting to manage abalone fisheries in a sustainable manner.

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Friends of the Ecological Reserves
P.O. Box 8477
Victoria, B.C.
V8V 3S1

Jane Watson
64 Pirates Lane,
Nanaimo, BC, Canada
V9R 6R1

June 4, 2001

Dear Friends,

Thank-you for your continued support of sea otter research off the West Coast of Vancouver Island. Your support, over the last 10 years, has allowed for this long-term study of sea otter community interactions. This summer I will continue to monitor the permanent sites that I established in 1986-1987 as well as carrying on a number of ongoing projects examining various components of the shallow near-shore community in the Checleset Bay area. I will send you a summary of my work upon my return in late September.

Enclosed please find a paper on the interactions between sea otters and abalone that I presented to an international meeting on abalone last spring – the Friends are acknowledged as having supported this research. The long-term data I present is research that you have directly supported.

Thank-you again for all of your help – both financial and verbal.

Sincerely,

Jane

Jane Watson