THE IMPACT OF HUMAN ACTIVITIES ON KILLER WHALES IN JOHNSTONE STRAIT AND ROBSON BIGHT

- Draft **Background Report** -

(16 August 1990)

by

Johnstone Strait Killer Whale Committee

August 16, 1990

First, the killers were rounded up into a tight formation with concentrated machine gun fire, then moved out again, one by one, for the final blast which would kill them. Other whales helped the troops, for as one was wounded the others would set upon it and tear it to pieces with their jagged teeth. The sea was red with blood. The scene of destruction was terrible. I have never seen anything like it.

- newsman account of US NATO troops acting upon a request by the Icelandic government to reduce the number of killer whales off Grindavik, Iceland in the early 1950's (Time Magazine 4 October 1954).

Quote from an article giving a more recent view

August 16, 1990

SUMMARY

TABLE OF CONTENTS

August 16, 1990

August 16, 1990

August 16, 1990

I INTRODUCTION

Wide recognition now exists that Johnstone Strait is the best location in the world to see killer whales. Killer whales enter Johnstone Strait daily during summer to feed on salmon, socialize and rest and to rub on pebble beaches near Robson Bight. Resting and rubbing are rare elsewhere. Recently, the federal Department of Fisheries and Oceans, British Columbia Ministry of Parks and the public have raised concerns that potential threats exist to these whales continued use of this region. The threats are from human activities in Johnstone Strait and Robson Bight such as whale watching, logging and commercial fishing.

Until about 20 years ago, killer whales shared the waters of Johnstone Strait mainly with commercial fishermen and other commercial vessels. However, since then human activities in the region have grown dramatically. In the early 1970's researchers began routine annual monitoring of killer whale abundance and behaviour. Through the 1970's an increasing number of people travelled to the region to watch the whales from small boats. Also, a paved road was completed in 1979 from Campbell River to Port Hardy which made Johnstone Strait more accessible. Public concern increased during this time to protect killer whale habitat and this resulted in halting plans plans announced in 1978 to develop a log handling facility at Robson Bight. In 1982, the British Columbia Ministry of Parks designated this area as the Robson Bight Ecological Reserve.

The unique killer whale viewing opportunities in Johnstone Strait and Robson Bight provided the impetous for the development of a whale watching industry beginning in 1981. Killer whale whale watching tours now originate from Telegraph Cove, Alert Bay, Kelsey Bay, Malcolm Island and Vancouver. Also, during this time increases continuted in the number of small boats, kayakers and commercial film companies that visit the region to see killer whales. Commercial cruise lines and in transit boat traffic divert their courses to see the whales. In addition, whale watching is popular with sportsmen in small boats who are attracted to the region mainly for salmon fishing. When whales travel nearby, sportsmen frequently stop fishing to follow the whales.

The boat congestion around the whales threatens to discourage them from entering Johnstone Strait. To reduce this congestion, the Department of Fisheries and Oceans distributed boating guidelines to whale watchers (e.g. whale researchers, tours, recreational boats, photographers) and the British

Columbia Ministry of Parks hired wardens to patrol the ecological reserve to inform boaters of the reserve boundaries and boating guidelines. In addition, logging roads are now being constructed near the reserve which could end the isolation of the rubbing beaches and resting areas. Logging operations adjacent to the reserve could also result in habitat degredation at the rubbing beaches. Finally, commercial fishing is undertaken in the reserve at the rubbing beaches and resting areas when whales are present and these activities interfere with the whale's use of the reserve.

Given the importance of Johnstone Strait and Robson Bight to killer whales and the value of killer whales in this region to the public, measures need to be taken which will ensure that a suitable environment is provided for the whales. To that end, the federal Minister of the Department of Fisheries and Oceans and the Minister of the British Columbia Ministry of Parks have jointly appointed a task force, called the Johnstone Strait Killer Whale Committee, to propose management options for consideration by the two levels of government. The Committee is composed of ten members each of whom has particular expertise to allow the Committee to address the broad range of issues which are expected to be raised regarding management of killer whales in the region. Their expertise includes ocean and land habitat, killer whale biology, tourism, forestry, native affairs and the management of parks, commercial fisheries and whales.

The mandate of the Committee (Appendix 1) is to assess the importance of Johnstone Strait and Robson Bight to killer whales, to assess the impact of human activities on killer whales and their environment and to suggest management options that will ensure the continued presence of killer whales in Johnstone Strait and at Robson Bight. The Committee will examine the impact of all human activities in the Robson Bight area and the impact of whale watching activities in other areas of Johnstone Strait.

To carry out its mandate, the Committee has prepared this Draft Background Report which outlines the issues and management options. Views on the report are sought from all interested parties in order to decide on which options will become management recommendations. Open houses/public meetings will be held in Vancouver, Victoria and Port McNeill to provide information and to receive written and oral comments. These meeting schedules will be announced in newspapers. In addition, private meetings with selected interested parties will be arranged.

Following receipt of comments the Draft Background Report will be revised to take into consideration any new issues or options

raised. The Committee will then evaluate the various options and select, in light of public input, those options which will become its recommendations. The Revised Background Report will then be distributed to representative groups for additional comment. The Final Background Report will be submitted to executives of the Department of Fisheries and Oceans and Ministry of Parks and later released to the public.

II REGIONS OF CONCERN

The regions of concern to this Committee are the waters and shorelines of western Johnstone Strait, their eastern and western approaches and the Robson Bight Ecological Reserve and its adjacent lands and waters. A description now follows of the main physical features of these regions.

A. Western Johnstone Strait

Western Johnstone Strait is the most frequently used coastal waters in British Columbia by killer whales (Fig.1). This body of water, which lies along a northwest axis, is located off northern Vancouver Island between Beaver Cover and Adams River. It is 40? km long by about 4 km wide and bordered to the south by Vancouver Island and to the north by small islands adjacent to mainland British Columbia. The Vancouver Island side consists largely of steep mountainous terrain assending to 1000 m whereas on the northern islands a more gradual incline to lower peaks is found. The vegetation covering the slopes on both sides is dominated by forests, most of which are in various stages of regrowth following logging. On both sides the shore drops sharply into water, typically to 350 m in depth (up to 500 m). Human access to this region is mainly by boat. However, it can be reached from the Vancouver Island side by way of logging and public roads which feed from the inland highway between Campbell River and Port Hardy down to Adams River, Telegraph Cove and Beaver Cover. Logging roads are also present on the north side islands, but these roads do no connect with the mainland.

Killer whales enter western Johnstone Strait from the west through narrow passes between Hanson Island, Swanson Island, Malcolm Island and Cormorant Island, which are low (<200 m) and forested. These passes are shallower (typically 100 m) than western Johnstone Strait. Further to the west are the open waters of Queen Chalotte Strait which join with Hecate Strait and ultimately with the Pacific Ocean off northwestern Vancouver Island.

The whales enter western Johnstone Strait from the east by way of

eastern Johnstone Strait. Eastern Johnstone Strait extends an additional 40 km east to Chatham Point and tends to be narrower (2 km), shallower (200 m) and with higher (1500 m) mountainous borders on both sides than western Johnstone Strait. Further to the east and northeast are numerous narrow channels eventually connect with Georgia Strait to the southeast. Georgia Strait in turn joins to the southwest with Juan de Fuca Strait and the latter with the Pacific Ocean off southwestern Vancouver Island.

B. Robson Bight Ecological Reserve

The Robson Bight Ecological Reserve is located in western Johnstone Strait along the Vancouver Island shore (Fig.1). The reserve is 17.6 km^2 in area with 10.7 km of shoreline from the eastern boundary at Schmidt Creek to the western boundary at Sir John Creek (Blood et al 1988). The marine component is 1248 ha with an outer boundary extending approximately 1 km from shore, except at Robson Bight where it reaches to 2.3 km. The land component is 512 ha and is 200-1500 m deep (mostly 400-700 m) from the shoreline. The deepest portion occurs along the Tsitika River which drains the Tsitika Valley and watershed into Robson Bight. The land is steep and rocky except for the flood plain and estuary of the Tsitika River. Much of the marine portion is precipitous decending to 400 m or more in depth.

Access to the reserve is mainly by boat. However, a logging road has been extended along the shoreline from Eve River? and Naka Creek? to within 1 km of the eastern boundary and down the Tsitika Valley from the inland highway between Campbell River and Port Hardy to within 7? km of the reserve boundary. Blood et al (1988) have prepared a detailed account of the physical and biotic characteristics and other features of the reserve.

III BIOLOGY OF KILLER WHALES

A. World

Killer whales inhabit the inshore and offshore waters of all oceans of the world from the edge of the polar pack ice to the tropics (Heyning and Dahlheim 1988). Throughout this extensive range only one species exists, Orcinus orca. It is characterized by distinctive black and white markings which differ slightly between regions. Adult males can reach 9.8 m in length and females 8.5 m. In adult males the dorsal fin reaches 1.8 m compared to 0.9 m in adult females.

The largest concentrations of killer whales appear to occur in the cooler coastal waters of both hemispheres. Although no estimate of the total population size has been made, the species is not considered to be abundant anywhere. Migrations are reported in polar regions where seasonal ice formation occurs, but elsewhere only local seasonal movements probably take place. The species is an opportunistic predator feeding on a wide variety of fish, squid and marine mammals. This whale has no natural enemies, although small numbers have been taken for food or predator control by whalers off Japan and Norway and in the Antarctic and small numbers have also been taken for aquaria from British Columbia, Washington and Iceland (Hoyt 1990).

B. British Columbia

The species has been studied extensively in British Columbia since the discovery that each individual can be recognized by unique natural markings. Two races have been identified, called resident and transient (Bigg et al 1990). The races differ slightly in appearance of the dorsal fin and saddle patch. Although they use much of the same habitat, they have never been seen to mix. Many other biological differences exist as well. For example, residents feed almost exclusively upon fish whereas transients feed almost exclusively upon marine mammals. Residents frequently visit the inshore areas during summer whereas transients occur irregularly at any time during the year. Residents typically travel in groups of 10-20 individuals while transients travel in groups rarely exceeding 5 individuals. Transients rarely vocalize while residents commonly vocalize. Many of these differences are suspected to have developed in the two races from hunting two different types of prey.

The biology of residents is more completely understood than for transients. Residents travel groups called pods. A pod is composed of one or more adult females and their offspring and can contain up to four generations. Individuals travel with their closest relatives in their pod all of their lives (Bigg et al 1990). A new pod forms by the gradual splitting of an existing pod along maternal lines. Each pod has its own dialect of 5-12 stereotype calls (Ford 1989). Of the 19 resident pods in British Columbia, 16 containing 190 whales comprise a northern community. This northern community ranges along xxx km (Graeme knows) of the coast from the mid-latitudes of east and west coasts of Vancouver Island to southern southeastern Alaska. The remaining 3 pods with 80 whales forms a southern community which ranges xxx km (Graeme knows) from the southern boundary of the northern community south into Puget Sound, southern Vancouver Island and west coast of Washington. Both communities likely spend most of their time in offshore areas, perhaps within a few hundred km of shore in

British Columbia. The resident pods in both communities enter the inshore waters of British Columbia most frequently during May-October. During this time the whales feed extensively upon salmon which are migrating to rivers for spawning.

The life span of female residents has been calculated to to be up to 80-90 yr and of males 50-60 yr (Olesiuk et al 1990). Females give birth to their first viable calf (survives to 0.5 yr) at age 15 yr and by 40 yr produce an average of 5 viable calves after which age calf production ceases. Males begin to develop their distinctive tall dorsal fin at an average age of 15 yr and reach full size at 21 yr. The population size of northern community has increased at an average annual rate of 2.96% between 1973 and 1988 and, is estimated to have increased at a similar rate since 1955. The southern community has increased at a rate of 1.5% between 1974 and 1988. The lower rate in the southern community resulted from the cropping of whales (at least 34, perhaps 48) for zoos and aquaria during the mid-1960's to the early 1970's (Olesiuk et al 1990, p. 14, 118). A small number (at least 14, perhaps 15) were also taken from the northern community.

The reason for the increase in the northern community could be: 1) recovery of the population from reduction due to shooting and harassment by federal fisheries personnel, fishermen and the public prior to the mid 1960's as well as from military bombing during World War 2 (Olesiuk et al 1990); 2) an improved natural environment such as increased food supply; and 3) a long-term natural cycling of the population with the current phase increasing.

Transients tend to travel in pods which are also composed of close relatives, although some dispersal of offspring appears to take place. Transients have a large coastal range, extending 1200 km? (Graeme knows) along the coast from southern Puget Sound, Washington to northern southeastern Alaska. The transients do not respect the territorial boundaries of the two resident communities. There are about 100 transients in 45 pods which comprise a single community.

C. Western Johnstone Strait

During summer, the northern resident whales enter western Johnstone Strait from Queen Charlotte Strait by way of the narrow channels between the islands that lie to the west of western Johnstone Strait (Fig.2). They usually travel back and forth between approximately Adams River and the northwest side of Hansen Island for several days, perhaps leaving for a few hours or days before returning. The main exit from western Johnstone Strait is to Queen Charlotte Strait. However, sometimes they

travel eastward to Campbell River and Jervis Inlet and return to western Johnstone Strait and then exist to Queen Charlotte Strait. When whales leave Queen Charlotte Strait they travel throughout the remainder of the northern community range.

Ford (1984, p.20) divided the behaviour of northern residents in western Johnstone Strait and adjacent areas into five cateogories: foraging, travelling, socializing, resting and beach rubbing (see also Jacobsen, 1986, p. 146; Osborne 1986, p. 219 [in the behavioural biology of killer whales book]). Except for beach rubbing, all behaviours are undertaken throughout western Johnstone Strait. Foraging is undertaken by individuals and small groups and is by far the most most common activity (67% of their time). Foraging bouts average 2.6 hr (Ford 1984).

Travelling is the least frequent activity (4%), and lasts usually 0.9 hr. Resting on the surface and during slow swimming is a common activity (13%). Sometimes the whales remain stationary at the surface. Average resting bouts last 2.1 hr. Socializing, which comprises physical interactions, jumping, play and sexual activity is a fairly common activity (12%) and lasts typically 1.9 hr. Beach rubbing, which consists of slow swimming back and forth over pebbly beaches and with the flank, belly or side gently touching the pebbles, is rarely undertaken outside of Robson Bight Ecological Reserve (see Robson Bight Ecological Reserve). Rubbing has been seen occasionally at Lizard Point, eastern Malcolm Island. No beach rubbing has been reported by the southern resident community of killer whales.

Pods of the northern community rarely visit western Johnstone Strait between December and May (Fig. 3). When they do they simply travel through on their way eastward or westward and rarely forage, rest or socialize or beach rub. In mid-June the number begins to increase and in early July the number increases sharply. Peak abundance occurs during August which on average consists of about 30-40 whales a day. Numbers decline steadily until November. During July-September 1980-86, residents were seen on an average of 86% of days (417/486) (JJ letter; Linda Nichol has better data; I have it).

The resident whales move into Johnstone Strait in early July to feed on the migrating salmon and depart when the migrating salmon have passed through in November. The whales feed upon chinook, chum, sockeye, pink and coho salmon in western Johnstone Strait (Bigg et al 1990b; paper given at KW symposium in Victoria GE or JF has title).

All northern resident pods usually visit Johnstone Strait each year during July-September. However, but not all pods visit with

equal frequency (Fig. 3). Only 4 of the 16 pods were seen on more than 20% of the days. All pods have considerable annual variability in their occurrence. For example, pod A1 which is the most commonly seen did entered the region only one in 1982? and pod A5, the second most common pod did not enter the region in 1985?. Based on the number of whales days (ie one whale present on one day) the northern community uses western Johnstone Strait only about 15-20% of the time during July-September (Fig. ; I'll derive from Linda Nichols data). Thus, most of the northern community time during the summer is spent outside of the region.

- need to incorporate Fig 9 of Linda's thesis here somewhere; to say that not all pods use the strait in equal amounts of time

Transient killer whales are seen only occasionally in western Johnstone Strait during summer and fall. These whales tend only to travel and forage and do not swim back and forth in the region as do the residents.

D. Robson Bight Ecological Reserve

When the northern resident killer whales enter the Robson Bight Ecological Reserve, they usually rest, beach rub and feed. The main area for beach rubbing and resting is in the eastern portion of the reserve close to shore (Fig. 1). Ford 1984 (p. 33) reported that when whales were rubbing at the beaches they did so for an average of 0.6 hr (up to 1.5 hr) and Briggs (1990) reported that the average whale rubbed for 0.1-0.2 hr/day. The reason for beach rubbing is unknown but some suggested reasons are to remove skin parasites, for pleasure and for socializing.

In Robson Bight the main activities are foraging and resting. Foraging takes place on the salmon which congregate along the bluffs and deep waters of the eastern side of Robson Bight. Rubbing occasionally takes place on a small pebble beach at the west side of Robson Bight.

Transients occassionally pass through the Robson Bight Ecological Reserve, but they do not beach rub, forage or rest in the area.

IV HUMAN ACTIVITIES

The following description of human activities in western Johnstone Strait and its adjacent waters and lands is provided to indicate the potential sources for interactions between people and killer whales.

A. Communities

In western Johnstone Strait and the adjacent areas lives a of about xxxxxx people involved in logging, fishing, mining and tourism. Within western Johnstone Strait are three are logging camps: 1) Adam River where xxxx people are employed by MacMillan and Bloedel?; 2) Eve River with xxx workers for Western Forest Products?; and 3) Beaver Cove where xxx are employed to work for MacMillan and Bloedel. About xx people operate a marina and whale watching tours at Telegraph Cove.

Immediately to the west of western Johnstone Strait are three fishing and logging towns: 1) Alert Bay has a population of xxx; 2) Port McNeill has xxxxx people; and 3) Sointula has xxxx. Further to the west is Port Hardy, the largest community in the region with xxxxx people employed in logging, fishing, mining and tourism. Immediately to east of western Johnstone Strait and on the mainland is Port Neville which is home to about xx people involved with logging and fishing. Further to the east at Kelsey Bay are xxx people employed with logging, fishing and tourism.

B. Fishing

Salmon is by far the valuable fish caught in the region. The main fishing season is July-October. Commercial salmon fishing takes place throughout Johnstone Strait and its western approaches. An estimated xx seine boats, xx trollers and xx gillnetters fish in the area, most of which originate from local communities. Some boats come from other ports along the British Columbia coast. Seining and gillnetting are common in the Robson Bight Ecological Reserve. Seiners tie their nets to the shore near the rubbing beaches to make a set. Sport salmon fishing takes place mainly in western Johnstone Strait and particularly its western approaches. These boats are small and motorized most of which are privately owned, but some are chartered. A small number of boats commercially fish for rockcod, lingcod, and red snapper in the western entrance to western Johnstone Strait.

C. Logging

Logging in the region consists of road building, timber cutting and sorting and transporting logs by road or water to other locations for processing. Operations are undertaken largely during spring to fall?. Logging has been going on in this region since the late 1800's and thus cut areas are in a broad range of stages of regrowth (Fig. needed?). During the past 10 years, road construction and cuts have taken place on Cracroft Island and on Vancouver Island at Eve River, Naka Creek and Telegraph Cove. Most of the other areas were cut 10-30 years ago. A dryland log sort is located at Adam River?, Eve River? and at Beaver Cover

and a log booming ground is located at Beaver Cove. Sorted logs are transported to market by train, truck or tug.

D. Tourism

The opening of the highway from Campbell River to Port Hardy in 1979 has made the region accessible to tourists who visit during summer and fall to fish for salmon, take nature tours and sightsee. The nature tours are principally to see killer whales and to experience wilderness areas. Five tourboat companies, located at Telegraph Cove, Port McNeill, Malcolm Island, Kelsey Bay and Vancouver, took 10,000 tourists to see killer whales in the region during 1989. An estimated 4000 kayakers launched their kayaks at Telegraph Cove and Naka Creek in 1989. Pleasure boats from local areas and from other coastal regions in British Columbia frequent these waters as well to fish and watch killer whales. During 1989, an estimated xxxxx launches were made at these three sights. Cruise ships in transit between southern British Columbia and Alaska make particular mention to their passengers to watch for killer whales in western Johnstone Strait. During fall to spring reefs around the small islands at the western approaches to Johnstone Strait are popular scuba diving areas.

E. Research and photography

Research on killer whales in western Johnstone Strait began in 1970 and has continued each year since by numerous institutions and individuals (Appendix Table 2). These studies examined abundance, population dynamics, reproduction, seasonal movements, feeding habits, vocalizations, social organization, body growth, diving patterns, swimming speeds, beach rubbing and numerous other aspects of behaviour as well as studies on the interactions between people and killer whales (Appendix Table 3, needed?). The research usually involves following individually recognizable whales from small motorized boats and monitoring the whales' activities. Some studies are made from land.

Since the early 1970's professional photographers, television documentary crews, television news and film makers from around the world have come to western Johnstone Strait to document killer whales for public information (Appendix Table 4). The photographs are usually taken by following the whales in a small boat, but also from land, the air and underwater.

F. Other marine traffic

In addition to the vessel traffic associated with the activities described in A-F, western Johnstone Strait is also used as the

main passage for merchant and military traffic that travel the inside passage. Merchant traffic includes tugs with barges, freighters, small oil tankers and other commercial vessels. Military vessels include frigates?. Also, the Canadian Coast Guard and Department of Fisheries and Oceans research and patrol vessels. During a year xxxxx such vessels are estimated to ply these waters (Table ?; if there are data on usage from Dept Transport include). [busiest channel on BC coast?]

G. Native affairs (what to put in here?)

A total of xxxx native people live in Alter Bay, Port McNeil and Sointula. Their main employment is fishing and logging. Abandoned native villages in the area are located mainly at the western entrance to western Johnstone Strait (Fig. 1). Native people have had no tradition of hunting this whale. Rather, this whale was considered a benevalent spirit, as evidenced on totem poles now standing at Alert Bay. A recent claim was made by the Tlowitsis-Mumtagila chiefs for ownership to the lands in the Tsitika Valley adjacent to the Robson Bight Ecological Reserve.
[size of the native community; number of tribes and names; main work?]

H. Boats

Many human activities in this region involve the use of boats for fishing, transportation, commerce and pleasure and it is boats which most often bring people into contact with killer whales.

1. Western Johnstone Strait

During 1984-85, commercial fishing boats were by far the most common vessels (90%) to use the waters of western Johnstone Strait (Table 1). Their daily numbers fluctuate considerably being most abundant on days when salmon fishing is permitted in the area. They can number up to 141 at any one time. Pleasure craft were the second most abundant boats. The number of whale watching boats has increased from 2 in 1985 to 6? in 1989 and thus they would currently make up a slightly greater percentage of the boats present. The number of commercial fishing boats has remained relatively constant?? from 1985 to 1989. The number of boats used by researchers and photographers varies between years depending upon the number of projects completed and initiated, although rarely exceeds 5 boats in a year.

- expand?

2. Robson Bight Ecological Reserve

During 1987 and 1989, observations were made of vessel activity during July-August from blinds overlooking the rubbing beach area (see Briggs 1990 p. 10). As in western Johnstone Strait, commercial fishing boats are by far the most common (84%) (Table 1) to visit the rubbing beach areas. Seine boats frequently arrived several days before fishing begins in order to acquire a preferred fishing site. Seiners lined up at the beaches to make sets and gill-netters also fished within 10-50 m from shore throughout the reserve. A total of 4? favored sites (tie-ups) are located near the rubbing beaches and x elsewhere in the reserve (Fig. needed?). During fishing operations considerable boating activities take place such as bringing in provisions, repositioning of vessels and transporting fish.

Seiners and gillnetters were present at the rubbing beach area for 24 hr a day for 4-7 days a week. They often moored on the rubbing beaches and in coves immediately adjacent to the beaches. During 1989, gunfire was heard on 35% of the days that commercial vessels were moored near the rubbing beaches and a total of more than 500 gunshots were heard. Most shots were directed at shore, but sometimes targets in the water were used such as jumping salmon. A possible shooting at killer whales by a gill-netter was recorded in 1987. On one occasion in 1989 the explosion was heard of possible "seal bombs" thrown into the water.

The second most common boat type in the rubbing beach area were pleasure craft plus kayakers. Their numbers might have been much higher had the information officer of the BC Ministry of Parks, who was stationed near the reserve, not discouraged these boats from entering the reserve. During 1987, Taylor (1988b) contacted 557 people in pleasure craft near the research. Other vessel activities in the reserve includes tugs towing log booms often within 100 m of shore and taking sometimes several hours to pass through the area. Very few visits were made to the rubbing beach area by whale watching boats, researchers or photographers.

I. Land

1. Western Johnstone Strait

Human activities adjacent to the reserve were primarily associated with logging immediately to the east of the reserve. Road blasting was heard on 16 occasions in 1987 and 9 occasions in 1989 (Briggs 1990). Siltation from road building and rains was observed once at Schmidt Creek during summer 1989. Road construction continued down the Tsitika Valley and has reached 7? km from the inland boundary of the reserve. In November 1989, extensive siltation from the Tsitika River was reported in Robson Bight following heavy rains which washed out part of the new

logging road (Briggs, pers. com). Nonlogging activities on adjacent lands in 1989 included picnicking (3 occasions) and camping (3) at Schmidt Creek.

- problems elsewhere in western Johnstone Strait

2. Robson Bight Ecological Reserve

People do not commonly go ashore near the rubbing beaches (Briggs 1990). However, of those who do go ashore, commercial fishermen are the most frequent. In 1987, two landings were recorded and 27 in 1989. Commercial fishermen did not go ashore in 1987, but did 19 times in 1989. Fishermen went ashore in their skiffs and stayed 5-50 min to hike, tie mooring lines, whale watch, check rifle targets or make a fire. Recreational boaters and kayakers went ashore mainly to look for a camp site. In addition, on 30 July 1989 a pair of hikers walked from Schmidt Creek to the rubbing beaches and photographed the whales beach rubbing.

V IMPACT OF HUMAN ACTIVITIES

Four potential impacts of human activities on northern resident killer whales are considered: 1) the effect of disturbance from boats and people on land on killer whale behaviour in western Johnstone Strait and Robson Bight Ecological Reserve; 2) the net effect of all human activities on the annual use of Johnstone Strait by resident killer whales; the net effect of all human activities on the productivity of the northern resident community; and 4) the potential effect of logging activities adjacent to the reserve on killer whale habitat in the reserve.

A. Disturbance

1. Boats

a) Western Johnstone Strait

i) Boat encounters

Duffus and Dearden (1989?) described the number of each boat type and the duration of encounters involved in boats which followed killer whales in western Johnstone Strait (includes Robson Bight Ecological Reserve). During the summers of 1986, 1987 and 1989, a daily average of 5.7, 5.5 and 6.6 encounters took place respectively between boats and whales. On any one day the number of encounters ranged from 0 to 24. During these years a total of 1067 encounters were logged (Table 3). The boats which most frequently approached killer whales were motorized whale watching

charters (24%), small motorized pleasure boats (24%) and researchers (18%). Other boat types approached whales much less frequently. Encounters by whale watching charters (both motorized and sail), kayaks and small and large sail boats tended to increase in number between 1986 and 1989.

Whale watching charter boats and researchers followed whales the longest, about an hour (Table 4). Other boats remained only about half as long. A slight tendency existed for whale watching charters, pleasure sail boats and kayks to remain longer with the whales between 1986 and 1989. The upper range of times which all types of boats spent with the whales exceeded 100 min and reached 420 min by researchers. During 1989, the most common number of boats following the whales was 4, but ranged from 1 to 12 (Figure 4; see data for this fig at end of report).

Other encounters consist primarily of encounters with commercial fishing operations. Apart from periodic encounters between travelling whales and fish boats, whales also encounter gillnets and seines set in the region. The whales rarely entangle in gillnets (Borrowman has one incident 1990) and are captured in seines, and if captured are usually released alive. On rare occasions a fishing hook either from troller or sport fisherman gear, will snag on the body of a killer whale (eg Alex Morton has one incident in 1986?). Other boat encounters include these by tugs towing logbooms and barges, cruise ships, and numerous other maritime vessels. Only on rare occasions does an encounter detrimentally impact killer whale. For example, in August 1974, a ferry at Comox, south of Campbell River, fately struck a killer whale with its propeller. In summer 1986? (Borrowman or Bain knows), a operators of a seiner were charged with shooting at killer whales near the reserve, although they were not convicted of harassment to the whales.

ii) Killer whale reaction

Killer whales avoid boats which approach them too closely by increasing speed, altering direction of travel, diving for longer periods of time or dispersing. Kruze (1984) reported that killer whales in Johnstone Strait increased their swimming speed by 1.4 times during 84 situations in which boats approached within 400 m. Swimming speed tended to be greater with an increase in the number of boats. The size of the boat did not seem to influence the degree of avoidance. Whales did not commonly change direction of travel due to disturbance. Duffus and Dearden (1989 Table 4) also reported that in 134 cases where boats approached whales within 300 m in Johnstone Strait swimming direction tended not to change. However, in 67 cases they did not report a change in swimming speed. They noted that in 159 encounters, most (67%)

groups of whales tended to become more dispersed.

Over the years, killer whale researchers in western Johnstone Strait have also gained considerable knowledge in the reaction of killer whales to boats although their findings have not been quantified or published. The following is a summary of this knowledge as provided by G. Ellis, J. Ford, M. Bigg, N. Rose, B. Bain, J. Jacobsen and others? (this part needs circulating to all but JJ he's got a copy of the following. Killer whales show considerable variability in their reaction to boats. The variability depends upon how close the boat approaches the whales, the course and speed of boat approaches, the behaviour which the whales are undertaking at the time, the apparent mood of the whales and the length of time that the whales are followed. Killer whales show little reaction to any boat activity more than 300-400 m away. Within that distance the likelihood of whale avoidance typically increases progressively the closer the boat approaches the whales. However, sometimes whales will begin avoidance behaviour at 300-400 m and sometimes will not until the boat is <10 m away. On occasion individual whales will approach a boat within 2 m and even swim in the wake.

Within 300-400 m, the whales tend to be disturbed more when boats approach them from the front than from the side or rear. An approach by a boat at high speed (>10 km/hr?) will almost always result in killer whale avoidance. However, whales can commonly be approached up to 50 m away without avoidance if the approach is dead slow, from the whales' flank and whales are in an approachable mood. However, at this close distance whales appear to become more evasive with time and by about 0.5 hr usually cannot be approached as closely. A mood change of a pod is also evident when the same pod allows a close boat approach on one day, but not another. Also, killer whales tend not to be as disturbed when approached whale foraging or travelling as when they are resting, socializing or beach rubbing. Some acclimation to close boat approaches appears to take place as the summer progresses, although Kruze (1984) did not find this.

b) Robson Bight Ecological Reserve

Briggs (1990, p.) examined the reaction of killer whales as they encountered commercial fishing boats, whale watching boats (charter, research and recreational) and commercial marine traffic near the rubbing beaches. Commercial fishing boats accounted for 61% of the encounters in 1987 and 50% in 1989??? (data in revised report seems wrong; same numbers given for two separate situations p. 15 and p. 17). On average, 76% of the 356 total encounters recorded resulted in a reaction by the whales

including: leaving the area (31%), having a shorter than usual rub at the beach (16%), passing through the area without rubbing (13%), leaving and then returning (11%) and other reactions (5%).

Disturbance to whales outside, but near the reserve appears to influence their behaviour when they subsequently visit the rubbing beaches and also the behaviour of whales which are already at the beaches. Of the 41 interactions noted by Briggs (1990) between boats and killer whales just outside the reserve 73%, resulted whaling tending to have a shorter rub, change direction or pass by. In cases where a pod or several pods split such that part went to the rubbing beaches and part remained outside the reserve, disturbance caused to the whales outside the reserve also resulted in the whales which had entered the reserve to leave.

On the occasion when two apparent seal bombs were dropped into the water near killer whales at the rubbing beaches, killer whales reacted by rapidly leaving the area. In two incidents when gunfire was heard from commercial fishing vessels moored near the rubbing beaches, killer whales reacted by leaving in one case and did not react in the second.

2. Land

a) Western Johnstone Strait

In western Johnstone Strait, outside the Robson Bight Ecological Reserve, killer whales often travel and forage close to shore, but they rarely rest or socialize there and do not rub. The most common sites where whales travel and forage close to land are along the shores of Blakney Pass, such as at Cracroft Point, southern Hanson Island and northern xxxx. Blakney Pass is the main route that the whales take into and out of Johnstone Strait from Queen Charlotte Strait. At these sites the whales frequently go within 100 m of shore at they enter and leave western Johnstone Strait. Orca Lab, which undertakes land-based research on killer whales is situated in this area on the eastern shore of Hansen Island. Thus, except for Blakeny Pass, people on land rarely have the opportunity to approach and potentially disturb whales from land.

b) Robson Bight Ecological Reserve

People can approach killer whales from land at the rubbing beaches and a variety of promentoories along the reserve shoreline. At the rubbing beaches people can stand on the pebble beaches and rocky shoreline and watch the whales rub or rest

within 3 m of shore. The reaction of whales to people on the beaches was recorded on 11 occasions when people were visible to the whales. During these occasions people were landing their boats or walking on shore and in all cases the whales left the beaches shortly after people were visible.

B. Seasonal abundance

1. Western Johnstone Strait

- summary data from Linda Nichol on the number of whale days by by month (July, August, September; totalled for whale subpods) for each year 1980-1990.
    - will show that large monthly variation exists
        - eg. July 10-25% of northern community uses J Str
              August 5-30%
              Sept 10-25%
    - no trend over the years to use the Strait less
        - thus, no overall impact by boats and other sources of human activities on whale use of area
    - I'll get this together

2. Haro Strait

For a comparison with Johnstone Strait, R. Osborne (The Whale Museum, Friday Harbour, Washington) summarized the annual the proportion of southern community of resident whales to visit Haro Strait during June-August 1980-90. Haro Strait is the core area of the southern resident community and thus comparable to western Johnstone Strait. The whales tend to enter Haro Strait about a month ealier than in western Johnstone Strait. The mean proportion to enter Haro Strait during for June-August 1980-89 was 23.1%, a figure similar to that seen in western Johnstone Strait (16%, about). The range of variation in Haro Strait for June was 6-40%, July, 12-50% and August 12-42%, thus similar to western Johnstone Strait. A tendency existed for a greater proportion to enter Haro Strait during the 1980's. Although some increase may result from slightly better data collecting procedure during this time, Osborne believes that an increase has occurred despite increased whale watching activities in Haro Strait. During 1980-86 the number of whale watching charter boats increased from x to x.

- I'll get this together

D. Net effect of human activity on productivity

The productivity of the northern resident community of killer

whales is defined here as the annual rate of change in population size. The annual rate varies depending upon the number of births and deaths that take place each year; it increases when births exceed deaths and decreases when deaths exceed births. Productivity is a particularly important measure of the relationship between the northern community and its environment because productivity is the net result of the interaction between many environmental factors, such as food availability, habitat suitability, weather and human activities throughout its range, and many killer whale biological factors, such as reproduction, mortality, disease and behaviour.

The annual rate of change in the population size of the northern resident community between 1973 and 1987 is calculated to be 2.9% (Olesiuk et al 1990) and may have remained at about this level since 1955. This rate is thought to be near the maximum possible for the population. Thus, the overall environment of the northern community has been optimal for many years. This indicates that, while human disturbance in western Johnstone Strait can disrupt the daily routine of the whales present, human disturbance there could not have substantially altered productivity. However, the northern community spends only a small proportion of its time (16%) in western Johnstone Strait during July-September and much less time in other months. Thus, the main factors which control productivity are likely to be outside of western Johnstone Strait.

E. Effect of logging adjacent to the reserve on killer whales in the reserve. (this section needs a rethink; omit human presence stick to habitat changes?; retype on table of contents)

Several human activities could result in habitat deterioration. One is the construction of logging roads near the reserve which would make the rubbing beaches and other shore areas more accessible to hikers, whale watchers and campers. The presence of people along the shore can be considered habitat deterioration because killer whales react adversely to human presence in the area. Similarly, increased recreational or commercial boat traffic in the reserve would result in habitat deterioration. Another human activity which could result in a potential detriment to the habitat is logging on the higher elevations adjacent to the reserve. Heavy rains could result in the flooding of logged areas or roads which could deposit silt and wood debris at the rubbing beaches and other areas of the reserve. Logging is underway in the upper Tsitika River watershed and a logging road, which is currently 4 km from the reserve is to be extended to the northern boundary of the reserve. Logging is also planned?? above the reserve to the east and west of the Tsitika Valley. The noise from road blasting and other logging activities could be

detrimental also.

The presence of people in boats (commercial fishermen, pleasure craft, researchers, photographers) at the rubbing beaches and other areas of the reserve can be considered to constitute a deterioration of the whales' habitat from early times because the whales are disturbed by human presence. Although the whales continue to use the reserve, human presence could still restrict the amount of use which the whales make of the reserve. Thus, the whales might spend more time in the reserve if boats were not present. In this sense, the whales' habitat could potentially be improved by the exclusion of boats from the reserve. Little else seems possible to improve the habitat.

VI MANAGEMENT ISSUES

The responsibility to manage killer whales falls primarily within the jurisdiction of the federal Department of Fisheries and Oceans. This body operates under the Department of Fisheries and Oceans Act and its numerous associated statutes, acts and regulations. These legislations provide a broad mandate which involves sea coast and inland fisheries management, fisheries science, fishing and recreational harbours and oceanography and hydrography. No specific mandate exists to manage killer whales. However, the Department of Fisheries and Oceans has the same responsibility toward managing killer whales, such as protection of habitat, enforcement of regulations and undertaking research, as toward all other marine animals and plants whether of commercial value of not.

Responsibility for the management of killer whales also lies with the British Columbia Ministry of Parks which provides, under the Ecological Reserves Act, for protection of the rubbing beaches and nearby habitat. This protection was given with the establishment of the Robson Bight Ecological Reserve in 1982. The main objective of this reserve was to protect killer whales from human disturbances and to provide long-term research and educational opportunities without disturbing the whales.

The management issues of the two levels of government concerning killer whales can be broadly divided into control over human disturbance of the whales in Robson Bight and western Johnstone Strait and protection of the whales' habitat in the Robson Bight Ecological Reserve. Four specific management issues are evident.

Issue No. 1. Control of disturbance by commercial fishermen in the Robson Bight Ecological Reserve.

The problem

The Robson Bight Ecological Reserve is important to killer whales primarily for rubbing on beaches and resting close to shore and this importance is now recognized world-wide. The biological significance of beach rubbing and resting in the reserve is not known, but the behaviours are unusual. The reserve is also used by commercial salmon fishermen to set their nets, to tie their nets to shore and to moor their boats. Whales use the rubbing beaches less when commercial fishing operations and associated leasure activities are underway there. Although whales and commercial fishing have coexisted for many years, the whales' use of the reserve appears to be nonetheless reduced by commercial fishing in the reserve. Also, commercial fishing in the reserve coupled with increased boat traffic outside the reserve, might together result in further reduction of use of the reserve by killer whales.

Recent management practices

Commercial fishing activities in the reserve have remained exempt from the restrictions placed on all other boat and land activities in the reserve. Thus, essentially no management practicies have been attempted to control disturbance to the whales by commercial fishing operations. About 1% of the visitor program contacts by the information officer for the British Columbia Ministry of Parks were with commercial fishermen (Taylor 1988b).

Jurisdiction and legislation

Under the Fisheries Act, the federal Department of Fisheries and Oceans has the jurisdiction to control the location and dates of commercial fishing in the Robson Bight Ecological Reserve. In addition, the Cetacean Protection Regulations provide jurisdiction to prevent chasing, harassing and shooting of killer whales. No restrictions on commercial fishing in the reserve have been applied because the problem of disturbance had not been studied. Also, no legal description of harassment has been formulated. An unsuccessful prosecution against a seine boat crew for shooting at killer whales was undertaken in 1986??.

The British Columbia Ministry of Parks has no jurisdiction to prevent the disturbance of killer whales by commercial fishing boats. The role of this ministry has instead been one to provide information about the whales' use of the reserve and the boundaries of the reserve. Although the ministry technically has the jurisdiction to prevent commercial fishermen from going ashore to tie their fishing nets????, this restriction has not

been enforced.

Key agencies and groups

Major agencies and groups having an influence on commercial fishing disturbance of killer whales in the reserve:

Groups	Role in whale disturbance
1. Commercial fishing industry	. No known protective activities
2. Department of Fisheries and Oceans	. Patrol vessels enforce regulations to prevent shooting at killer whales
3. B.C. Ministry of Parks	. Dissemination of information about killer whales in the reserve

The future

Commercial fishing practices in the reserve have remained essentially the same over the past few decades and so are unlikely to change in the future. Thus, interference with the whales' natural use of the reserve will continue. In recent years some commercial fishermen have taken an interest in whale watching within the reserve during their leasure time. This interest provides an additional source disturbance to the whales, particularly at the rubbing beaches.

Issue No. 2. Control of disturbance by recreational boaters, whale watching charter operators and researchers/photographers in western Johnstone Strait and Robson Bight Ecological Reserve.

The problem

Western Johnstone Strait and the Rosbon Bight Ecological Reserve are the most reliable places in the world to see killer whales. Tourists, researchers and photographers come from around the world to observe these whales. Recreational boaters, whale watching charter operators and resesearchers/photographers have the common goal of wanting to get close to the whales to observe them. However, close approaches and prolonged following can result in disturbance to the whales. During summer and fall the whales travel back and forth day after day in western Johnstone Strait and in Robson Bight Ecological Reserve. Whale watchers anticipate the whales' location and once found they follow them. Several boats may follow one pod. Whale watchers sometimes attempt to visit the reserve to see killer whales and thus

compound the disturbance caused there by commercial fishermen. Although no long-term detrimental impact from boat disturbance has been observed on the whales, such an impact could occur if sufficient disturbance takes place. Disturbance has increased through the 1980's associated with a shape increase in whale watching.

Recent management practices

1. Western Johnstone Strait

Guidelines have been issued for whale watchers in boats travelling in western Johnstone Strait outside of the Robson Bight Ecological Reserve. The guidelines requested that boaters:

- approach whales from the side or rear, not front
- not approach whales closer than 100 m
- approach and depart from the whales slowly

Researchers and photographers were exempted from the distance guideline for situations in which a closer approach was absolutely necessary. During 1982-85?, numbered yellow pennants were provided to researchers and photographers to fly on their boats for identification. xx pennants were issued. The issuing of pennants was discontinued because of uncertainties as to who should be responsible for issuing them.

2. Robson Bight Ecological Reserve

During 1980-90, two volunteer wardens have regularly visited the reserve to discourage recreational use of the land and water components of reserve. In 1982, guidelines were established for whale watching boats inside the reserve. The guidelines request that boater:

- refrain from entering the reserve when whales are present
- if whales are encountered within the reserve, keep at least 300 m away from them

Each summer during 1986-90, 1-2 information officers have been stationed at the reserve boundaries to inform boaters and whale watchers of the reserve boundaries and of the guidelines. A total 3-4?? 4'X8' signs have been erected along the shore of the reserve to inform boaters of the reserve and requesting that they stay away from the whales.

Researchers and photographers in boats are asked not to enter the reserve except when it is absolutely necessary. If entry is required than they are asked not to approach whales

closer than 300 m, dive with the whales or approach the rubbing beaches. During 1982-85??, researchers and photographers who had special need to enter the reserve were issued a pennant with a black tip for identification. Typically, only 1-2 permits are issued each year for research and photography on land at the rubbing beaches and these are issued with strick conditions regarding visibility, camping, moorage, number of people and dates.

The guidelines are in large measure adhered to by watching charter boat operators, researchers, photographers and other informed boaters. However, some recreational boaters are unaware of the guidelines and enter the reserve when information officers are not present. Also, commercial fishing boats and the small motorized boats associated with them do not follow the guidelines and enter the reserve to fish.

3. Communities

Each summer, the information officers give talks to tourists and recreational fishermen concerning the reserve and killer whales. These talks take place at Telegraph Cove and Port McNeil. A sign has been posted at the boat launching ramp at Telegraph Cove to inform recreational fishermen and kayakers about the reserve and killer whales. Also, a brochure which explains the reserve is available in local stores at Telegraph Cove for distribution. Numerous visits by the media to see the whales are informaed of the reserve and guidelines.

Jurisdiction and legislation

As noted in Issue No. 1 the primary responsibility for control of harassment by boats lies with the Department of Fisheries and Oceans. With a legal definition of harassment lacking, the main instruments of the Department of Fisheries and Oceans for controlling harassment is guidelines and education. These are also used by the B.C. Ministry of Parks.

Key agencies and groups

The main agencies and groups having an influence on the disturbance of killer whales by recreational boaters, whale watching charter operators and researchers/photographers in western Johnstone Strait and Robson Bight Ecological Reserve are as follows:

Group	Role in whale disturbance
1. Recreational boaters	. Adherence to guidelines.

2. Whale watching charter boat operators	. Adherence to guidelines. Set good example. Information distribution to public.
3. Researchers/ photographers	. General adherence of guidelines. Collection of data to assess and control disturbance. Information distribution.
4. Department of Fisheries and Oceans	. Issue guidelines. Enforcement of guidelines. Information distribution.
5. B.C. Ministry of Parks	. Issue guidelines. Issue permits for land-based research and photography. Information officers and volunteer wardens.

The future

The number of whale watching charter boat operators and, in particular, the number of recreational boaters using western Johnstone Strait can be expected to increase in the future as they have in the past decade. This increase will result in additional disturbance to the whales. The number of research boats and photographers using the region has remained at a relatively level over the past decade and seems unlikely to substantially change during the next decade. Research will need to be continued in order to monitor the impact of human activities on whale biology.

Issue No. 3. Control of logging road access to the Robson Bight Ecological Reserve.

The problem

Until recently, the reserve was accessible only by boat. However, a logging road has now been extended to the eastern boundary of the reserve and another will be extended to the northern boundary in the Tsitika Valley. Presumably a logging road will eventually be built to the western boundary. Road construction could facilitate public access to the reserve shore for hiking, camping and viewing whales. Camping at the eastern boundary and hiking into the reserve to view whales has been recorded. Human activity on the beaches of the reserve would be detrimental in that whales would use the beaches less.

Recent management practices

An upland buffer strip (of xx hectares??) near Schmidt Creek was acquired for the reserve in 1988 to provide a deterrent against public access to the shoreline. No other management efforts have been initiated to prevent land access to the reserve shoreline.

Jurisdiction and legislation

Control of land access to the reserve could be carried out under the Ecological Reserves Act and Regulations by an Order-in-Council as done for some other reserves. The Department of Fisheries and Oceans has no jurisdiction over land access??

Key agencies and groups

The main agency to control road access is the B.C. Ministry of Parks. Other agencies which have an influence on public land access are those which plan and/or build the roads near the reserve. These include the B.C. Ministry of Forests, MacMillan and Bloedel and Western Forest Products.

The future

Public access to the reserve by land will likely increase in the future as tourists become more familiar with remote areas of northern Vancouver Island.

Issue No. 4. Control over logging activities which may adversely affect killer whales in the Robson Bight Ecological Reserve.

The problem

Logging on the lands surrounding the reserve can result in more variable flows in Schmidt Creek and the Tsitika River which drain into the reserve; in soil erosion, sedimentation or debris accumulation on the foreshore; in blow-down of timber; in noise from road blasting and other disturbances associated with logging operations. Siltation from flooding during heavy rains has been reported in Schmidt Creek and the Tsitika River. While no adverse affects of such activities on the whales' use of in the reserve have been recorded, logging activities close to the reserve have only begun in recent years. Thus, the effect of such activities is yet not known.

Recent management practices

The management actions have been to acquire land buffers to

prevent shoreline habitat degredation and disturbance to the whales from logging activities. An upland buffer (xx hec ??) was acquired as well as land (xx hec??) in the Tsitika River estuary??.(dates??)

Jurisdiction and legislation

The Department of Fisheries and Oceans has jurisdiction under the Fisheries Act to ensure that logging operations in the adjacent lands do not adversely affect freshwater and marine habitats, including the habitat for killer whales. Staff from the Department of Fisheries and Oceans sit on the Tsitika Follow-up Committee to monitor logging practices in the Tsitika Valley. The B.C. Ministry of Parks has no jurisdiction over logging activities on lands adjacent to the reserve. However, it does have some influence through representation on land use committees, through B.C. Minitry of Forests referrals and by direct petitioning of log tenure holders.

Key agencies and groups

The main agencies having influence on logging activities are as follows:

Group	Role in preventing logging impacts
1. Department of Fisheries and Oceans	. Monitor logging operations. Enforce regulations to prevent aquatic habitat degredation.
2. B.C. Ministry of Parks	. Inspect the reserve. Enforce regulations to maintain integrity of the reserve. Influence peripheral land use.
3. B.C. Ministry of Forests	. Ensure logging operators adhere to Coast Logging Guidelines and Tsitika Watershed Integrated Resource Plan. Support research recommendations of the Tsitika Follow-up Committee.
4. Tsitika Follow-up Committe	. Ensure that the Tsitika Watershed Integrated Resource Plan is followed. Facilitate required research and monitoring.
5. MacMillan and Bloedel	. Adhere to Tsitika guidelines. Liaison with B.C. Ministry of Parks re potential wind-blow, access and

related problems.

6. Western Forest Products	. Adhere to Coast Logging Guidelines. Liaison with B.C. Ministry of Parks re logging plans adjacent to reserve boundary in rubbing beach area.
7. Nature Trust?? Canada	. Purchased land in the Tsitika River estuary for B.C. Ministry of Parks to administer??

The future

The problem of determining the impact of logging practices on killer whale use of the reserve is complex and poorly understood. However, because logging can potentially impact the whales' habitat in a detrimental manner, this problem needs to be examined in more detail in the future.

VII MANAGEMENT OPTIONS

The following list is of the main management options proposed for the management issues just raised. Associated with each option is a summary the likely advantages and disadvantages for the whales and people involved. The options are presented for comment from the public and interested parties in order to help the Johnstone Strait Killer Whale Committee to decide on which options should become management recommendations to the Canadian Minister of Fisheries and the B.C. Minister of Parks. Other issues and options raised by the public will also be considered.

- we'll have to talk with Louise about how this section should be done

Issue No. 1. Control of commercial fishing operations in the Robson Bight Ecological Reserve.

1. Status quo fishing.
   - A. Whales - advantage: none
     - disadvantage: disturbance continues
   - B. Fishermen - advantage: no distruption to fishing
     - disadvantage: none

2. Continued fishing allowed but with an education program for fishermen on ways to reduce disturbance to killer whales.
   - A. Whales - advantage: some reduction in disturbance
     - disadvantage: disturbance still exists
   - B. Fishermen - advantage: fishing continues in reserve

August 16, 1990

- disadvantage: restricted fishing near whales

3. Exclusion of fishing from area near rubbing beaches.
   A. Whales - advantage: undisturbed rubbing and resting
   - disadvantage: none
   B. Fishermen - advantage: none
   - disadvantage: loss of a few fishing sites, although no loss of fish

4. Exclusion of fishing from reserve.
   A. Whales - advantage: unrestricted rubbing and resting in reserve
   - disadvantage: none
   B. Fishermen - advantage: none
   - disadvantage: loss of more sites than Option 3, although no loss of fish.

Under Options 1-3 commercial fishing boats will be the only boats allowed in the reserve, except for intransit marine traffic (tugs, freighters). Other boats (whale watching, recreational, research and photographic) will be excluded as in the past.

Issue No. 2. - Control of disturbance by reactional boaters, whale watching charter operators and researchers/photographers in western Johnstone Strait and Robson Bight

1. Status quo for following the whales
   A. Whales - advantage: none
   - disadvantage: progressively more disturbance
   B. Boaters - advantage: no change in boating activities
   - disadvantage: perhaps fewer whales to see

2. Following whales is allowed, but an improved education program and updated guidelines to reduce disturbance
   A. Whales - advantage: reduced disturbance
   - disadvantage: some disturbance likely
   B. Boaters - advantage: whales stay in region
   - disadvantage: restricted activity near whales

3. Following whales is not allowed
   A. Whales - advantage: reduction in disturbance
   - disadvantage: none
   B. Boaters - advantage: whales stay in region
   - disadvantage: tourism and research reduced

Issue No. 3 - Control of logging road access to Robson Bight Ecological Reserve

1. Continue current road building practices

August 16, 1990

A. Whales - adavantage: none
- disadvantage: likely increased disturbance

B. Loggers - advantage: construct roads as planned
- disadvantage: none

2. Continue building roads, but install gates on roads to limit public access

A. Whales - advantage: reduces potential disturbance
- disadvantage: some disturbance still possible

B. Loggers - advantage: continue road construction
- disadvantage: minor cost for gate

3. Restrict road contruction near the reserve

A. Whales - advantage: further reduction in disturbance
- disadvantage: none

B. Loggers - advantage: none
- disadvantage: loss of road options and associated timber

Issue No. 4 - Control of logging activities which may adversely affect killer whales in Robson Bight Ecological Reserve.

1. Continue current logging practices in lands adjacent to the reserve.

A. Whales - advantage: none
- disadvantage: potential habitat degredation

B. Loggers - advantage: continue logging practices
- disadvantage: none

2. Stricter guidelines for logging practices to safeguard killer whale habitat

A. Whales - advantages: greater habitat protection
- disadvantage: still some risk of habitat degredation

B. Loggers - advantage: continue logging adjacent to reserve
- disadvantage: more operational costs

3. Restrict logging in lands adjacent to the reserve

A. Whales - advantage: greatest protection for habitat
- disadvantage: none

B. Loggers - advantage: none
- disadvantage: loss of timber adjacent to reserve

VIII MANAGEMENT RECOMMENDATIONS

REFERENCES

Bigg, M. A., G. M. Ellis, J. K. B. Ford and K. C. Balcomb. 1989. Killer whales. A study of their identification, genealogy and natural history in British columbia and Washington State. Phantum Press, Nanaimo, B.C.. 79 p.

Blood, D. A., I. B. MacAskie and C. J. Low. 1988. Robson Bight Ecological Reserve. Background Report. Report prepared for the Ecological Reserves Program, Victoria by D. A. Blood and Associates Ltd., Nanaimo, B.C.. 51 p. + 19 appendices.

Briggs, D. A. 1987. Census tables of boat traffic in the Johnstone Strait during the periods July 11 - September 1, 1984 and July 1 - September 1, 1985. Univ. Calif., Santa Cruz, Calif. 89 p.

Briggs, D. A. 1990. Impact of human activities on killer whales at the rubbing beaches in the Robson Bight Ecolgical Reserve and adjacent waters during the summers of 1987 and 1989. Report prepared for the Ecological Reserves Program, Victoria. 38 p.

Darling, J. D. 1986. Robson Bight Ecological Reserve Management Plan. An assessment of human activities on killer whales of the Robson Bight Ecological Reserve with mangement guidelines. Report prepared for the Ecological Reserves Progam, Victoria by West Coast Whale Research Foundation, Vancouver, B.C. 83 p.

Duffus, D. and P. Dearden. 1989?. A perspective on whale-watching and tourism in British Columbia. Unpubl. Rept., Dep. Geography, Univ. Victoria, B.C. 100 p.

Duffus, D, and P. Dearden. 1989. Non-consumptive use and management of killer whales (Orcinus orca) in Johnstone Strait, British Coumbia. Prepared for World Wildl. Fund Canada. Dept. Geography, Univ. Victoria. 15 p.

Ford, J. K. B. 1984. Call traditions and dialects of killer whales (Orcinus orca) in British Columbia. PhD thesis, University of British Columbia, Vanouver, British Columbia. 435 p.

Ford, J. K. B. 1989?. (a paper in Can J. Zool on calls)

Heyning, J. E. and M. E. Dahlheim. 1988. Orcinus orca. Amer. Soc. Mammalogists, Mammalian Species No. 304, pp. 1-9.

August 16, 1990

Kruze, S. L. 1984. The interactions between killer whales and boats in Johnstone Strait, B.C.. Unpubl. Rep., Univ. Calif., Santa Cruz, Calif. 15 p. + 8 figs.

Ministry of Environment. 1981. Killer whales and coastal log management: an overview of future uses of Robson Bight, British Columbia. APD Bulletin No. 6. 45 p.

Osborne, R. W. 1988. Whale watching trends and killer whale occurrence in greater Puget Sound. Presented to NOAA Whale Watching Workshop, Monterey, CA in November 1988. The Whale Museum, Friday Harbor, WA 98250.

Rennie, F. 1982. An assessment of the national significance of Robson Bight, British Columbia. Final Report, Parks System Palnning Division, National Parks Branch, Parks Canada, Ottawa. 77 p.

Taylor, R. E. 1988a. The use of a marine mammal reserve by researchers and photographers. Research paper, Natural Resource Management Program, Simon Fraser Univ.. 41 p. + appendices.

Taylor, R. E. 1988b. Visitor program at Robson Bight Ecological Reserve, summer 1987. Report prepared for Ecological Reserves Program, Victoria. 27 p.

Tilt, W. C. 1985. Whales and whale watchiong in North America with special emphasis on whale harassment. Yale School of Forestry and Environmental Studies, New Haven, Ct. 110 p. + appendices.

Table 1. Summary data of resident killer whales at the rubbing beaches during July-August 1987 and 1989. From Briggs (1990).

	1987		1989	
Number days observation	60?		60?	
Number of whales	142		123	
% of JStr whales at beach	90		92	
Number of whale days (% NC)	1288	(12.1)	645	(5.7)
Mean number of whales/day	22		11	
Mean duration of visit/whale	0.2		0.1	
Mean number of pod visits/day	3.08		1.62	

Table 2. The mean and maximum number of each boat type seen during 2875 half hour scans of western Johnstone Strait in July-September 1984-85 and the mean of the total number of each boat type to visit the rubbing beaches during July-August 1987 and 1989. Percentages in parentheses. From Briggs (1987, 1990).

Boat type	W. Johnstone Strait			Rubbing Beaches	
	Mean		Max	Mean	
Commercial fishing	23.4	(90)	141	1455	(84)
Commercial marine	0.7	(3)	5	55	(3)
Whale watching				5	(T)
Motor	0.1	(T)	4		
Sail	T	(T)	1		
Pleasure				144	(8)
Motor - large	0.6	(2)	9		
- small	0.4	(2)	6		
Sail - all	0.1	(T)	4		
Kayaks & canoes	0.4	(2)	17	60	(3)
Research & photographers	0.2	(1)	3	9	(1)
Total	25.9		141	1728	

August 16, 1990

Table 3. Number of occasions on which a boat approached within 300 m of killer whales to watch them in western Johnstone Strait during 1986-89. Data from Duffus and Dearden (1989, Table 1). Percent of total in parentheses.

Boat type	Year						Mean
	1986		1987		1989		1986-89
Whale watching charters							
Motor	78	(23.0)	74	(23.4)	104	(25.2)	256 (24.0)
Sail	11	(3.2)	16	(5.1)	38	(9.2)	65 (6.1)
Pleasure boats							
Motor - large	31	(9.1)	32	(10.1)	22	(5.3)	85 (8.0)
- small	72	(21.2)	102	(32.3)	84	(20.4)	258 (24.1)
Sail - large	19	(5.6)	18	(5.7)	27	(6.6)	64 (6.0)
- small	7	(2.1)	13	(4.1)	24	(5.8)	44 (4.1)
Kayaks	17	(5.0)	28	(8.9)	59	(14.3)	104 (9.7)
Research	101	(29.8)	33	(10.4)	54	(13.1)	188 (17.6)
Float plane	3	(0.9)					3 (0.3)
Total	339		316		412		1067

Table 4. Mean duration, and range, in minutes when a boat approached within 30 m of killer whales to watch them in Johnstone Strait during 1986-89. Data from Duffus and Dearden (1989, Table 2). Number of occasions in parentheses.

Boat type	Year								
	1986		1987		1989		1986-89		
Range									
Whale watching charters									
Motor	51.4	(76)	60.2	(74)	73.8	(104)	63.1	(254)	2 236
Sail	39.7	(10)	61.8	(16)	66.0	(38)	60.8	(64)	7 175
Pleasure boats									
Motor - large	32.9	(30)	30.3	(32)	37.8	(22)	33.2	(84)	4 107
- small	45.7	(69)	33.0	(102)	41.4	(84)	39.2	(255)	1 239
Sail - large	34.1	(21)	29.5	(18)	44.4	(27)	37.1	(66)	2 160
- small	19.7	(7)	22.5	(13)	41.4	(24)	32.4	(44)	5 127
Kayaks	17.1	(16)	21.3	(28)	37.2	(59)	29.8	(103)	2 113
Research	58.7	(89)	131.4	(33)	60.0	(54)	72.7	(176)	3 420
Total	46.5	(318)	49.2	(316)	53.7	(412)	50.1	(1046)	1 420

Figure x. Frequency distribution of the number of boats simultaneously following a group of killer whales (from Duffus and Dearden 1989?)

	Number of boats											
	1	2	3	4	5	6	7	8	9	10	11	12
# Times	37	57	64	93	72	34	28	19	3	4		1

Misc notes

Establishing a link between human activities and changes in the biology of killer whales is a complex problem. Many human activities take place in the region that could affect killer whales, such as disturbance, competition for the same food supply, pollution, habitat degradation and killing or removal for aquaria. Human activities could effect many aspects of killer whale biology, such as reproduction, mortality, distribution, social organization and behaviour. Human activities could result in a positive, negative or neutral impact. For example, a positive impact could be enhancing food supply or habitat which results in greater killer whale productivity or use of an area and a negative impact could be disturbance resulting in a change in distribution. A correlation between a human activity and a change in whale biology might be coincidental or cause and effect.

Killer whales can only be approached from land in the Robson Bight Ecological Reserve. Thus, only in the reserve is close human contact possible to killer whales. Inside the reserve, particualrly at the rubbing beaches, killer whales approach closely to shore often within 10 m and can remain stationary resting or rubbing on the beaches. The human activities which take place in the reserve and that bring people into close contact with the whales include activities along the shore-line during camping, day trips, exploration, resting, whale watching and seine net tie-ups. During 1987 and 1989 Briggs ( ) recorded xx cases of campers, etc.

- captivity
- disturbance of energy budget
- move her CR account
- Prior to the mid 1960's, killer whales were viewed by fisheries managers and the public as a nuisance predator on salmon and even dangerous to boaters. As a result this whale was frequently shot at and harassed by fisheries managers, fishermen and the public so as to discourage them from popular fishing sites. In fact, in 1960, a committee was struck in Campbell River to decide on the best manner by which to drive killer whales from local sportsfishing sites. The committee, which was composed on federal fisheries personnel, local conservation groups and sports fishing companies, concluded that a 50 mm machine gun should be mounted in Seymour Narrows and be used to drive the whales away. The cement footings for the gun were poured but the gun was never fired.
- As attitudes toward the whale became more sympatheitic to the whale shooting diminished. However, shooting killer whales has

not entirely stopped. Each year a few whale return to Johnstone Strait with fresh bullet holes in their backs or dorsal fins.

Between 1965 and 197x, x killer whales were taken from the northern resident community for zoos and aquaria. They were removed from three pods (A5, C1, I11).

In the future, commercial fishing interference with the whales's activities in the Robson Bight Ecological Reserve should be reduced or eliminated in order to allow the whales to use the reserve in manner which is natural as possible. Greater access to the reserve may result in the whales making greater use of western Johnstone Strait.

- native people, others
- while not part of the terms of reference some other issues were raised which need to be commented upon.
    - esthetics
    - need for other land areas for people to view the whales.