AN EVALUATION OF THE IMPACT OF COMMERCIAL WHALE WATCHING ON HUMPBACK WHALES, MEGAPTERA NOVAEANGLIAE, IN NEWFOUNDLAND AND LABRADOR, AND OF THE EFFECTIVENESS OF A VOLUNTARY CODE OF CONDUCT AS A MANAGEMENT STRATEGY

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by

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Abstract

Despite its reputation as an eco-tourist activity, there are concerns that the growing, often unregulated whale-watching industry may be impacting cetaceans. In 2001, a voluntary Code of Conduct for tour boat operators was introduced in Newfoundland and Labrador to minimize any such impacts.

The objectives of the present study were to test the feasibility of this new code as a management strategy, to explore the educational value of whale watching for passengers, to evaluate the effects of tour boat activity on whales, and to assess the effectiveness of code guidelines. The study was carried out in Witless Bay, the island's most popular whale-watching locale. Data were collected through operator surveys, passenger questionnaires, and observations of whale behaviour (and tour boat activities) from land, tour boats, independent research vessel, and via VHF-TDR tags.

Operator compliance with the code was found to be low (about 25% of trips), as operators tended to control the interaction with animals and frequently entered the 100 m exclusion zone. Passengers did not seem capable of enforcing the code, as they did not know the specific rules and were inclined to interpret operator behaviour benignly.

The educational value of whale watching was low. Formal educational deliveries developed by the investigators proved to be more effective in delivering knowledge about whale biology and the Code of Conduct. No post-trip increase in environmental awareness was detected.

Behavioural responses of humpbacks to tour boats included the adoption of a short-range horizontal avoidance strategy and higher frequencies of some surface activities. Compliance with the code was found to have little effect, possibly reducing responses such as trumpet blowing and tail slashes, but it did not have an influence on the horizontal response.

When boat disturbance increased (i.e. more boats and/or more code infractions), whales' blow intervals changed, indicating possible shifts of behavioural patterns (from foraging to travelling). This suggests that tour boat operators, by respecting the code or by maintaining a low number of infractions, may limit disturbance to the whales and the probability of animals swimming away from the food source.

Recommendations for increasing the effectiveness of whale watching management in Newfoundland and Labrador are provided.

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

- ACCOBAMS = Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
- ASCOBANS = Agreement on the Conservation of Small Cetaceans of the Baltic and North Sea
- ATANL = Adventure Tourism Association of Newfoundland and Labrador
- CCAMLR = Convention on the Conservation of Antarctic Marine Living Resources
- CITES = Convention on the International Trade of Endangered Species of Wild Fauna and Flora
- CMC = Center for Marine Conservation (US)
- CMS = Convention on the Conservation of Migratory Species of Wild Animals
- COSEWIC = Committee on the Status of Endangered Wildlife in Canada
- DFO = Department of Fisheries and Oceans (Canada)
- ESA = Endangered Species Act (US)
- FU = Fluke Up
- GATT = General Agreements on Tariffs and Trades
- GBRMPA = Great Barrier Reef Marine Park Authority
- GLM = General Linear Model
- GPS = Global Positioning System
- HNL = Hospitality Newfoundland and Labrador

- HSD = Honest Significant Difference (post-hoc statistical test)
- HWRT = Humpback Whale Recovery Team
- IATTC = Inter-American Tropical Tuna Commission
- IFAW = International Fund for Animal Welfare
- IUCN = International Union for the Conservation of Nature and Natural Resources
- IWC = International Whaling Commission
- KF = King Fisher (name of the boat utilised as tagging and observing platform)
- LFA = Low Frequency Active (sonar)
- LSD = Least Significance Difference (post-hoc statistical test)
- MA = Million Years Ago
- MICS = Mingan Island Cetacean Study
- MMC = Marine Mammal Commission (US)
- MST = Multi-Sensor Tag
- NAHWC = North Atlantic Humpback Whale Catalogue
- NAMMCO = North Atlantic Marine Mammal Commission
- NGO = Non-Governmental Organization
- NIFCO = Newfoundland Independent Filmmakers Cooperative
- NMFS = National Marine Fisheries Service (US)
- TB = Trumpet Blow
- TDR = Time Depth Recorder
- TS = Tail Slashing

- UNEP = United Nations Environment Program
- UNESCO = United Nations Educational, Scientific and Cultural Organization
- WDCS = Whale and Dolphin Conservation Society
- WRG = Whale Research Group, Memorial University of Newfoundland
- WWF = World Wide Fund for Nature

List of Appendices

Chapter 1 - Introduction

1.1 Cetaceans

Whales, dolphins and porpoises are known collectively as cetaceans, from the Latin *cetus* (a large sea animal) and the Greek *ketos* (sea monsters) (Carwardine, 2000). Cetaceans are a mammalian order and the most highly adapted to an aquatic environment. There are 85 extant recognised species and 41 sub-species (Rice, 2002; Reeves *et al.*, 2003) that are classified in 14 families and grouped into two suborders, the Mysticeti (baleen whales) and the Odontoceti (toothed whales) (Rychel *et al.*, 2004). A third order, the Archaeoceti, containing primitive cetaceans, is extinct, and is considered ancestral to the other two (Carroll, 1988).

Cetaceans are regarded as a sister group of the monophyletic Artiodactyla (O'Leary and Geisler, 1999) and the *Hippopotamidae* are considered to be their nearest extant non-marine relatives mainly based on molecular evidence (Gatesy, 1997; Shimamura *et al.*, 1997; Geisler and Uhen, 2003). Fossils show that cetaceans arose from terrestrial ancestors, known as mesonychids, more than 50 million years ago and followed distinct radiations (Carroll, 1988). These included (but were not limited to) the initial radiation of Archeocetes in the Eocene [45-55 Million Years Ago (MA)], the radiation of Odontocetes and Mysticetes (32-38 MA), and the later Miocene radiation of modern groups such as delphinoids and balaenopterids (12-15 MA) (Fordyce, 2002). Evolution from land dwelling organisms into fully aquatic organisms involved the acquisition of specific adaptations, including adaptations for thermoregulation, locomotion, diving, and for living in a hyper-tonic environment (Elsner, 2002). Sensory organs also adapted to the physical properties of the ocean[1] (Richardson *et al.*, 1995).

Cetaceans can be found in all of the oceans and in some rivers. Distribution patterns vary between, and within, families and are affected by demographic, evolutionary, ecological, habitat-related and anthropogenic factors (Forcada, 2002). Mysticetes appear to have periodical migrations with relatively consistent patterns over the years (Corkeron and Conner, 1999). Seasonal movements in odontocetes are far less consistent over time. Factors inducing migration include the biological cycle (e.g. social, reproductive and feeding needs) and environmental variables (e.g. prey availability, changes in water temperature, etc.). These factors may trigger the start of seasonal movements, although not all individuals will respond in the same way.

1.2 Conservation of cetaceans

1.2.1 Cetacean populations at 'risk'

The claim that humans have yet to cause the extinction of any cetacean species is becoming increasingly tenuous (Reeves *et al.*, 2003). Surviving total populations of two species, the baiji (Yangtze River dolphin, *Lipotes vexillifer*) and the vaquita (Gulf of

[1] These adaptations make cetaceans particularly susceptible to human impact. Thermoregulation, for example, is achieved through high blubber content, which makes animals prone to the accumulation of persistent organic pollutants in adipose tissue, at levels potentially dangerous for the animal. Adaptations of sensory organs to marine acoustic environments make cetaceans susceptible to the effects of noise.

California porpoise, *Phocoena sinus*), are thought to be in the tens and mid-hundreds, respectively, and are probably still declining (Zhou *et al.*, 1998; Jaramillo-Legorreta *et al.*, 1999). Only about 300–350 North Atlantic right whales (*Eubalaena glacialis*) remain, almost all of them concentrated along the heavily industrialized east coast of North America (Katona and Kraus, 1999). Although there may still be several hundred North Pacific right whales (*Eubalaena japonica*) in the Sea of Okhotsk, this species too has essentially disappeared from most of its range elsewhere in the North Pacific and is in grave danger of extinction (IWC, 2001). Some populations of other species, such as the grey whales (*Eschrichtius robustus*) in the North Atlantic and possibly the blue whales (*Balaenoptera musculus*) in the western North Pacific have been exterminated (Mead and Mitchell, 1984; Reeves *et al.*, 1998). The IIUCN (International Union for the Conservation of Nature) Conservation Action Plan for 2002-2010 reports many local and regional populations that are seriously depleted, including belugas (*Dephinapterus leucas*), Irrawaddy dolphins (*Orcaella brevirostris*), finless porpoises (*Neophocaena phocaenoides*), harbor porpoises (*Phocoena phocoena*), spinner dolphins (*Stenella longirostris*) and bowhead whales (*Balaena mysticetus*) (Reeves *et al.*, 2003).

1.2.2 Whaling

The greatest impact humans have had on cetaceans has been through whaling (Baker and Clapham, 2004). Whaling is the direct exploitation of cetaceans for either subsistence or commercial purposes. Although subsistence hunting dates back to the Stone Age, it was not until the Basques in the 1500s that large-scale whaling became a commercial enterprise (Gambell, 1999). These whalers caught an estimated 40,000 right whales in the North Atlantic between 1530 and 1610 (Aguilar, 1985). The Basques signalled the beginning of the modern whaling paradigm: discovery of the 'resource', exploitation until no longer commercially profitable, and shift to other areas or species (Ellis, 2002). Other large species traditionally hunted included the humpback (*Megaptera novaeangliae*), grey, sperm (*Physeter macrocephalus*) and bowhead whales. It was not until the arrival of the industrial revolution (mid-to-late 1800s) that even faster species (blue, fin, *Balaenoptera physalus*, sei, *Balaenoptera borealis* and Bride's whales, *Balaenoptera brydei*) could be pursued.

Indeed, with the aid of technical innovations (e.g., explosive harpoons, steam engines, compressors, factory ships, stern slipway, etc.) and more intensive effort, several whale populations were brought to the brink of extinction. In the Antarctic alone, more than 2 million whales were killed, reducing the large Southern Ocean populations to small fractions of their original size (Clapham and Baker, 2002). Arising from concerns over the effects of this overexploitation, in 1946 the International Whaling Commission (IWC) was established with the goal of managing whale stocks[2]. A variety of management plans were adopted (Blue Whale Unit, New Management Plan, Revised Management Plan) and in 1982 a global moratorium on whaling was implemented as a precautionary measure given the lack of scientific knowledge on whale populations.

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[2] The IWC was created under the International Convention for the Regulation of Whaling. There is now an on-going debate among the signatory countries regarding which of the cetacean species should fall under IWC jurisdiction, and in particular whether other species in addition to baleen, sperm and bottlenose whales (*Hyperoodon spp.)* should be included.

Nevertheless, the exploitation of some species of whales has continued under the convention's provisions for scientific research. In 1986, Iceland, Japan and Norway began performing 'scientific' whaling on fin, minke (*Balaenoptera acutorostrata*), Bryde's, sperm, and sei whales (7437 whales in total). Currently, Japan and Iceland are the only countries still carrying out this kind of whaling. Japan is suspected of using it as a cover for commercial purposes; indeed, whale products from 'illegal catches'[3] have been found in Japanese markets (Baker *et al.*, 2000).

Between 1985 and 2002, a further 16,831 whales were harvested by Japan, Russia and Norway 'under objection' of the IWC zero catch quota. Norway continues to harvest about 600 minke whales a year (data available from: www.iwcoffice.org/conservation/catches.htm). Disclosures of widespread illegal catches by the Soviet Union revealed that the Soviets took in excess of 100,000 more whales in the Antarctic than were reported to the IWC (Yablokov *et al.*, 1998). These included protected and already depleted species such as southern right whales (*Eubaleana australis*), humpback, and blue whales.

Two decades have now passed since the global moratorium and this reprieve has helped some stocks to recover (e.g. eastern Pacific grey whales), while others still suffer from the effects of commercial whaling (North Atlantic right and blue whales) (Clapham *et al.*, 1999a).

[3] Species for which there is no quota under the IWC scientific permit (e.g. humpback whales).

1.2.3 Indirect human impact

Today, although the direct exploitation of cetaceans is no longer a major threat to most whale populations, human pressure on marine environments is increasing. Cetaceans are thought to be particularly susceptible to anthropogenic impacts due to their life history characteristics, including low reproductive output, high position in marine food webs, low genetic variability, high fat content, and dependence on certain specific habitats (Murray and White, 1998; Berta and Sumich, 1999). Indirect human impacts include: collisions with ships (Katona and Kraus, 1999; Laist *et al.*, 2001; Knowlton and Kraus, 2002); fisheries by-catch (NMFS, 2004; Ross and Isaacs, 2004; Lesage *et al.*, 2004); habitat loss and degradation (Katona and Kraus, 1999; Clapham *et al.*, 1999a; Rossiter, 2001; Bearzi *et al.*, 2004); climate change (Simmonds and Mayer, 1997; Würsig *et al.*, 2001; Taylor, 2003; Lusseau *et al.*, 2004); noise from ship traffic and industrial activity (Perry, 1998; Borggaard *et al.*, 1999; Würsig and Richardson, 2002); pollution (Aguilar *et al.*, 1999; Martineau *et al.*, 1999; Kajiwara *et al.*, 2004; Marsili *et al.*, 2004); and whale watching (Corkeron, 1995; Erbe, 2002; Williams *et al.*, 2002a; Bejder and Samuels, 2003; Samuels and Bejder, 2004).

The relative importance of these impacts is difficult to gage, both because the situation varies according to the species, population, locale, etc., and because most species are exposed to multiple threats, the effects of which cannot be simply estimated by adding them up (emergent properties). Examples of species that are currently facing multiple anthropogenic threats include the Northern right whale (loss of habitat, vessel strikes, entanglements, pollution), vaquita (loss of habitat, by-catch, pollution) and killer whales (*Orcinus orca*) (pollution, loss of habitat, prey competition, whale watching) (Baird, 1999; Jaramillo-Legorreta *et al.*, 1999; Knowlton and Kraus, 2002).

These examples show that human impact has shifted from direct exploitation to more indirect 'global' pressures deriving from the effect that modern society is having upon entire ecosystems. Human population increases, depletion of resources, an increased demand for energy, global pollution and encroachment of natural habitats are all affecting cetaceans. Some populations that were reduced in numbers by direct human exploitation in the past now may fail to recover due to 'new' subtle human threats that are more difficult to solve (Clapham *et al.*, 1999a).

1.2.4 The precautionary approach

In order to be effective, good conservation measures must take into consideration the multiple factors that affect natural populations of cetaceans. Measures must be based on sound scientific research and on the *precautionary principle*[4] (Stebbing, 1992; Jackson and Taylor, 1992). The precautionary principle or the *precautionary approach* has been put into use by governments and international organizations as a guide to activities

[4] The original concept of the precautionary principle has been around for a long time (i.e. better safe than sorry); officially, this term was born in Germany in the 1930s, used in regards to optimal household management. It was first used in terms of environmental issues in the beginning of the 1990s.

affecting the environment. Examples include the IWC global moratorium on the harvesting of whales (1982), the Biodiversity Convention (1992), the Straddling and Migratory Species Convention (1995) and the Cartagena Protocol on Biosafety (2000). The major concepts of the precautionary approach as used in these important international treaties are reported in Table 1.1 (Van Dyke, 2004).

Table 1.1: The Precautionary Approach (Van Dyke, 2004).

THE PRECAUTIONARY APPROACH	
1)	Studies must precede action, and interdisciplinary environmental impact assessments must be written and distributed with public input.
2)	The burden of proof must shift to those who undertake a new development or use an environmental resource, replacing the old approach that had placed the burden on environmentalists to challenge such an activity.
3)	Those who want to undertake new developments must engage in scientific studies to determine the effect of their initiatives and also consider less intrusive alternative approaches.
4)	Respect must be accorded to ecosystems and living creatures for their own sake, without requiring that they prove themselves to be useful or to have marketplace value.
5)	The idea that risks and costs can be transferred from one region to another, or from this generation to future ones must be rejected. Also the risks and costs must be internalised in order to proceed with a project.
6)	We must proceed slowly in the face of uncertainty, constantly testing and monitoring the effects of our activities.

In an effort to conserve wild populations of cetaceans, and considering the lack of knowledge concerning factors affecting their biology and population dynamics, the precautionary principle suggests that human action should only proceed in a conservative way. Regarded from an evolutionary perspective, anthropogenic impacts represent a new form of trauma for cetaceans and these animals may not be ready to cope in ways that would ensure their sustainability.

1.2.5 Conservation options

Conservation has been defined as: "the preservation of wild populations so that they can continue to replicate themselves, in a natural context, for an indefinite time in the future" (Reeves, 2002). This necessarily means that not only the animals but also the environments (ecosystems) that sustain them must be preserved. Conservation efforts are presently in place for the preservation of cetaceans (acknowledging the fact that many species of cetaceans are currently still viable only thanks to market laws – that is, they were reduced to such low numbers that exploitation was no longer profitable). These efforts include: international conservation conventions and institutions, national legislation, local and individual efforts, creation of protected areas, strategies to enhance individual survival and reproduction, reduction of environmental pollution, reduction of conflicts with fisheries, and reduction of disturbance and direct harm from vessel traffic.

1.2.5.1 International conservation conventions and institutions

Presently cetaceans benefit from protection at an international level (Reeves, 2002). In Table 1.2 are reported some of the most important international and bilateral conservation conventions and institutions and their primary mandates.

Table 1.2: Examples of international conservation conventions and institutions protecting cetaceans (Reeves, 2002).

NAME	YEAR created (# of signatory countries)	LOCATION OF SECRETARIAT	PRIMARY MANDATE
IWC (International Whaling Commission)	1946 (70)	Cambridge, UK	Conservation of whale stocks
CITES (Convention on the International Trade of Endangered Species of Wild Fauna and Flora)	1973 (169)	Geneva, Switzerland	Regulation and monitoring of international trade in products from threatened animals
IUCN (International Union for the Conservation of Nature and Natural Resources	1948 (91)	Gland, Switzerland	Maintains list of red species and sponsors specialist groups, advisory functions
WWF (World Wide Fund for Nature)	1961 (30)	Gland, Switzerland	Lobbies for conservation, supports research and participates in international conventions
CMS (Convention on the Conservation of Migratory Species of Wild Animals) or Bonn Convention	1979 (97)	Bonn, Germany	Conservation of populations that cyclically and predictably cross one or more national boundaries
CCAMLR (Convention on the Conservation of Antarctic Marine Living Resources)	1980 (24)	Hobart, Tasmania, Australia	Facilitation of recovery of depleted whale stocks, prevention of further irreversible changes in the Antarctic
United Nation General Assembly Drift-net Resolution 46/215	1991 (191)	None	Elimination of large-scale, high seas driftnet fishing
IATTC (Inter-American Tropical Tuna Commission)	1949 (15)	La Jolla, CA	Regulation of tropical Pacific fishing to reduce dolphin mortality
NAMMCO (North Atlantic Marine Mammal Commission)	1992 (4)	Tromso, Norway	Management of marine mammals in the North Atlantic
ASCOBANS (Agreement on the Conservation of Small Cetaceans of the Baltic and North Sea)	1991 (10)	Bonn, Germany	Cooperation to achieve and maintain a "favourable conservation status" for small cetaceans in the region
ACCOBAMS (Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area	1996 (18)	Monaco	Extended to all cetaceans, prohibiting any take and establishing "specially protected areas to conserve cetaceans"

The advantages of international agreements include that they are broad in scope and that they can, theoretically at least, provide protection for large areas. The drawback is that they only work if all the parties involved ensure compliance and enforcement. Also, at times, countries do not accede to conventions without assurance of being able to opt out. A good example is the case of Norway, a country that is now whaling commercially under the objection of IWC zero catch quota (Clapham and Baker, 2002).

1.2.5.2 National legislation

Cetaceans also benefit from legislative protection at a national level. Some examples are:

1) USA - Marine Mammal Protection Act (1972)
2) Canada - Marine Mammal Regulations under the Fishery Act (1993)
3) UK - Wildlife and Countryside Act (1981)
4) New Zealand - Marine Mammals Protection Act (1978)
5) Australia - Whale Protection Act (1980) and Endangered Species Act (1992)

The USA Marine Mammal Protection Act (MMPA) set the cornerstone for cetacean protection with its scope and comprehensiveness. This Act was, in fact, the first to de-emphasise the focus on economical yield, putting priority instead on the health and stability of ecosystems. Its explicit goals were to maintain populations near their natural level instead of protecting them only after they had declined to dangerously low levels (Barlow and Reeves, 2002). Some of its principles are summarised in Table 1.3. In other countries, various pieces of legislation now confer legal protection to cetaceans.

Table 1.3: Excerpt from the USA Marine Mammal Protection Act (MMPA) 1972.

USA MARINE MAMMAL PROTECTION ACT 1972 (Re-authorised in 1994)	
1)	Certain species and population stocks of marine mammals are, or may be, in danger of extinction or depletion as a result of man's activities.
2)	Such species and population stocks should not be permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem of which they are a part, and, consistent with this major objective, they should not be permitted to diminish below their optimum sustainable population level.
3)	Measures should be taken immediately to replenish any species or population stock, which has diminished below its optimum sustainable level.
4)	There is inadequate knowledge of the ecology and population dynamics of such marine mammals and of the factors, which bear upon their ability to reproduce themselves successfully.
5)	Marine mammals have proven themselves to be resources of great international significance, aesthetic and recreational as well as economic.

The MMPA established a moratorium, with certain exceptions, on the '*taking*' of marine mammals in US waters and by US citizens on the high seas, and on the importing of marine mammals and marine mammal products into the United States. The term '*take*' was statutorily defined to mean the following: "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal". Under the 1994 amendments, the Congress defined and divided the term '*harassment*' to mean any act of pursuit, torment, or annoyance which:

1. **Level A Harassment** - has the potential to injure a marine mammal or marine mammal stock in the wild; or
2. **Level B Harassment** - has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioural patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.

International laws and bodies can sometimes influence national conservation efforts. For example, attempts by the USA to reduce by-catch in the tropical pacific tuna fishery have been negatively affected by the fact that they are also part of the General Agreement on Tariffs and Trades (GATT) (Reeves, 2002). A US embargo on tuna imports from Mexico, put in place due to the practice of encircling schools of dolphins with purse seines, was challenged under the GATT. The resolution panel ruled that the embargo was inconsistent with GATT provisions (Reeves, 2002).

Conversely, the IWC, through international pressure from governments and non-governmental organizations (NGOs), has forced Japan to implement a management plan and to establish government quotas for the dolphin hunt in coastal waters, during which an estimated 17,000 dolphins are killed per year (Endo *et al.*, 2005).

1.2.5.3 Protected areas

The designation of specially protected areas (e.g. reserves, sanctuaries, parks) is a tool that is increasingly used to achieve conservation goals. There are more than 30 areas worldwide where cetaceans are granted special protection. Some selected examples are reported in Table 1.4.

"The main advantage of this kind of conservation initiative is that both the species and the ecosystem upon which the animals depend are designated for protection" (Bates, 2003). Buffer zones can be created to reduce disturbance. The benefits of protection may also extend to other species that inhabit the same area. Nevertheless, protected areas are often created in response to a public outcry, but without an accompanying ongoing commitment to establish and enforce meaningful restrictions on human activities. Furthermore, "they may provide false reassurance that space and resources have been set aside for wildlife, thereby relieving the public pressure for other meaningful conservation action" (Reeves, 2002).

Table 1.4: Examples of protected areas that benefit cetaceans (from Reeves, 2002).

NAME OF AREA	LOCATION	YEAR created	BENEFITS TO CETACEANS
IWC Indian Ocean Sanctuary	Indian Ocean, 20-130E and from 55N	1979	Ban commercial whaling
IWC Southern Ocean Sanctuary	Circumpolar south of Antarctic Convergence	1994	Ban commercial whaling
Great Barrier Reef Marine Park	Off Cape York, Queensland, Australia	1975	Preserve humpback whales, Indo-Pacific humpbacked dolphins (*Sousa chinensis*) and dwarf sperm whale (*Kogia sima*)
Banks Peninsula Marine Mammal Sanctuary	East Coast of South Island, New Zealand	1988	Limit gill netting; protect Hector's dolphins (*Cephalorhynchus hectori*)
International Sanctuary for Mediterranean Cetaceans	Ligurian Sea, Northwestern Mediterranean basin	1999	Regulation of whale watching, limit high-speed competitions, etc. Benefits fin, sperm whales and dolphins
Vikramshila Gangetic Dolphin Sanctuary	50 km Ganges River, Bihar, India	1991	Protection to Ganges River dolphins, regular surveys
More than 20 protected areas	South Africa coast and nearshore waters	1970	Protection from disturbance by vessels for right whales and odontocetes
Stellwagen Bank National Marine Sanctuary	Off Cape Code, MA, USA	1993	Restrictions on fishing and dumping. Benefits humpback whales and other cetaceans
Glacier Bay National Park and Preserve	Alaska, USA	1980	Regulation of vessel traffic to protect humpback whales
Channel Islands National Marine Sanctuary	Southwest of Santa Barbara, CA, USA	1980	Prohibits exploration for oil and gas, dumping. Benefits different species of cetaceans
Saguenay-St Lawrence Marine Park	Lower St Lawrence River, QB, Canada	1998	Protection from disturbance by vessels for belugas and baleen whales
The Gully	Off Nova Scotia, Canada	2004	Long-term protection for deep-water canyon ecosystem, protection for endangered northern bottlenose whale (*Hyperoodon ampullatus*)
Galapagos National Park, Whale Sanctuary	Galapagos Island, Ecuador	1990	Full protection for all cetaceans
Pacaya-Samiria National Reserve	Peruvian Amazon	1972	Restrictions on commercial exploitation and industrial activity. Benefits boto (*Inia geoffrensis*) and tucuxi (*Sotalia fluviatilis*)
Golfo San Jose' Marine Park	Peninsula Valdes, Argentina	1974	Protection to Southern Right Whales

1.3 Whale Watching

In the following sections I will introduce the concept of whale watching, its history, recent development, and a review of the possible contributions of this relatively new activity to cetacean conservation.

1.3.1 Definition of whale watching

Whale watching is the human activity of encountering cetaceans in their natural habitat (in this thesis, the definition more specifically applies to activities where humans intentionally seek such an encounter). This term is used to denote a wide range of activities that involve various species of whales, dolphins, and porpoises. Indeed, some authors suggest that it would be more appropriate to refer to it as 'cetacean watching' (Garrod and Fennel, 2004), but this term has never caught on. Whale watching encompasses both formal and informal activities and can be recreational or commercial (sometimes with a scientific component). The following activities generally fall under the term whale watching (and are usually managed together): watching cetaceans, snorkelling and diving with cetaceans, and feeding dolphins. Whale watching takes place from different platforms, including motorized vessels (cruise ships, ferries, commercial tour boats, recreational boats, sea-doos, etc.), vessels under sail or manually propelled (such as kayaks and canoes), fixed-wing airplanes, helicopters, and from cliffs and beaches.

1.3.2 History of whale watching

It is difficult to trace back to the origin of recreational whale watching but likely it began as coastal humans encountered stranded whales and near-shore species. In modern times, whalers kept detailed notes on animals they hunted and their seasonal occurrence, thus contributing to early studies of cetaceans (e.g. Scammon, 1874). Whales have been kept in captivity to be displayed to the public at least since the mid-1800s (Reeves and Mead, 1999). It was not until the middle of the 1900s, however, that commercial activities to view cetaceans in the wild began. In 1955 the first commercial whale-watching operation started, charging customers $1 US to see grey whales during their winter migration off the coast of San Diego, USA (Hoyt, 2002). During the 1960s, whale watching spread along the Californian coast to Oregon and Washington State, and in 1971 the Montreal Zoological Society organized the first commercial trip on the east coast of North America in the St. Lawrence River, Canada (Hoyt, 2002).

Tours to see humpback whales began in New England and Hawaii in 1975 (Hoyt, 2001). In New England, operators established their own brand of commercial whale watching with strong scientific and educational components, and within a decade whale watching developed there more than anywhere else in the US (Hoyt, 2001). The commercial success was likely connected to the fact that the important feeding ground of Stellwagen Bank (7 miles north of the tip of Cape Cod) is located close to large population centres of the US east coast (Hoyt, 2002).

Indeed, it is the coastal humpback whale that has made commercial whale watching into a lucrative industry. Humpback whales tend to be more active than other species and often display spectacular surface behaviour. Some individuals, especially calves, occasionally approach boats. These characteristics make humpback whales ideal for whale watching (especially for customers wanting pictures and entertainment).

1.3.3 Recent growth of commercial whale watching

Whale watching has now become a worldwide industry. Around 90 countries, territories or dependencies have some level of commercial whale watching (including Antarctica). Most of the 85 species of cetaceans are included in whale-watch programs (Hoyt, 2001). The most common species for commercial whale watching are humpback whales, grey whales, northern and southern right whales, blue whales, minke whales, and sperm whales, although the percentage of whale watchers who focus on smaller cetaceans such as the short-finned pilot whales (*Globicephala macrorhinchus*), killer whales, and bottlenose dolphins (*Tursiops truncatus*) is increasing (Hoyt, 2001).

Between 1991 and 1998, the number of people participating in whale watching increased from 4 to 9 million a year, with an average growth of 12.1% per year (Fig 1.1). In 1994 the United States was the first country to report more than a million whale watchers a year. By 2001, there were two other locations that could make this claim: Canada and the Canary Islands (Spain); Australia and South Africa meanwhile reported half a million whale watchers annually, with these figures expected to increase (Hoyt, 2001). Australia, New Zealand and Japan have also seen a recent dramatic increase in the number of people participating in swim-with-dolphin tours (Hoyt, 2001).

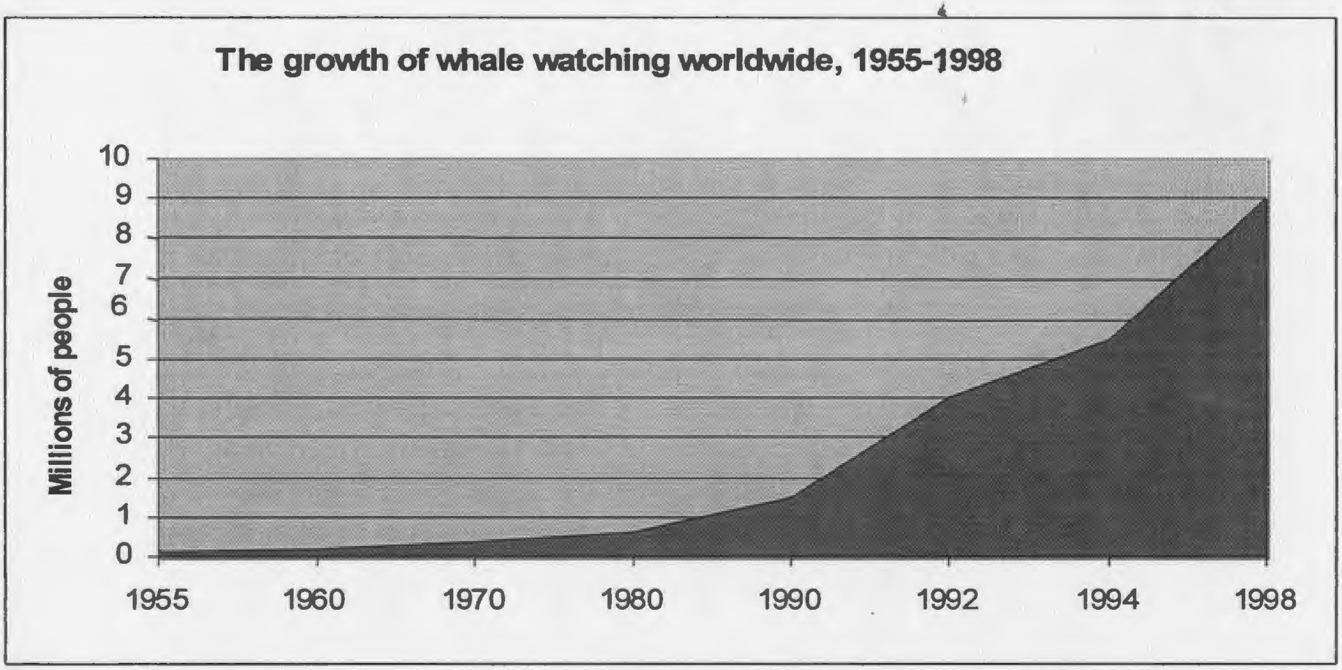

Fig. 1.1: Worldwide growth in the number of people whale watching between 1955 and 1998 (Hoyt, 2001).

The most common form of whale watching is boat-based (72% of all whale watching), while more than 2.55 million people in ten main countries participated in land-based whale watching (27.9% of all whale watching). Less than 0.1% of all whale-watching (< 10,000 participants a year) consisted of fixed-wing or helicopter tours (Hoyt, 2001).

1.3.4 Economic value of whale watching

Whale watching is a multi-million dollar industry. Globally, direct expenditures (money spent on the tours themselves) increased from $77 million US in 1991 to $299.5 million US in 1998 (with an average annual increase of 21.4%) (Hoyt, 2001). The total expenditures (the amount whale watchers spent on tours, as well as travel, food, hotels and souvenirs) increased from $317.9 million US in 1991 to $1,049 million US in 1998 (with an average annual increase of 18.6%) (Hoyt, 2001).

In many countries, whale watching is a primary form of international tourism and, as such, a source of foreign currency. However, the United States, Australia, Japan and the United Kingdom draw the majority of whale watchers from their own countries. The fastest growing whale-watch country is Taiwan, going from zero to about 30,000 whale watchers between 1994 and 1998. In the same period, the four next highest rates of increase were for Iceland (251% average annual increase), Italy (140%), Spain (124%) and South Africa (113%). The fastest growing continental region for whale watching is Africa, with an average 53% annual increase between 1994 and 1998, followed by Central America and the West Indies (47% each) (Hoyt, 2001).

It is interesting to note that the three countries that support the resumption of whaling are also currently benefiting greatly from whale watching. Iceland's extraordinary average annual growth rate of 251% from the mid-to late 1990s is one of the highest ever growth rates in whale watching. Whale watching in Japan and Norway also grew faster than the average world rate throughout the 1990s. In 1998, Iceland had 30,330 whale watchers who spent \$6.5 million US, Japan had 102,785 whale and dolphin watchers spending an estimated \$33 million US, and in Norway, 22,380 people took whale watch trips, spending more than \$12 million US (Hoyt, 2001).

1.3.5 Whale watching and promotion of cetacean conservation

Recently it has been argued, largely by various NGOs, that whale watching may promote cetacean conservation (Corkeron, 2004). The main reasons given are that: observation of whales promotes conservation; commercial vessels are a platform of opportunity for research; and whale watching provides a viable economic alternative to whaling.

Whale watchers (especially those seeing whales for the first time) often report experiencing a sense of awe and respectful admiration towards whales (Payne, 1995; Blanchard, 1999). Some authors have concluded that whale watching encourages a conservation ethic, based on passengers' expressed intention to become more involved in conservation efforts after 'establishing a connection' with cetaceans through whale watching (Forestell and Kaufman, 1990; Malcolm and Duffus, 2003). Other authors warn, however, that even if a short- or long-term attitudinal change may occur, this is not necessarily followed by behavioural changes and environmental action (Leeming *et al.*, 1993; Orams, 1997; Lee Meinhold, 2003).

Nevertheless, it is a fact that enhanced public attention gained through whale watching has sometimes contributed positively towards cetacean conservation in certain areas. One example is the designation of the Stellwagen Bank as a U.S. National Marine Sanctuary in 1993, a result of the public interest in whales raised in New England and in the Northeast of the United States through whale watching (Hoyt, 2002). After almost 20 years of whale watching, during which millions of passengers had learned about research and conservation issues, there was overwhelming popular support to establish a sanctuary.

Another argument is that whale watching facilitates the scientific investigation of cetaceans by providing an opportunity for research. Partnerships among tour boat operators and researchers are now happening all around the world. Examples include New England (US), Quebec (Canada), Norway, various areas in the Caribbean, and Italy (Robbins, 2000).

In New England, for example, in 1995, 50% of tour boat operators were contributing photographs of humpback whales to the North Atlantic Humpback Whale Catalogue (NAHWC). As a consequence, this is one of the best-known populations of humpback whales around the world, with 50% of the North Atlantic population now catalogued (Seton *et al.*, 2003). A second example is the use of data recorded by commercial whale-watching operators around the Isle of Mull, Scotland to assess the relative abundance of minke whales (Leaper *et al.*, 1997).

Cetacean research is a costly endeavour, making free passage for researchers on a whale-watching vessel, estimated to be worth around $1,000 US a day or even more in remote areas, an important contribution (Williams and Hammond, 2003), At the same time, other authors note that there is only a limited amount of research that can be conducted on whale-watching vessels; practises such as transect surveys, biopsy sampling, tagging, and collection of skin and faeces samples cannot be performed (Bejder and Samuels, 2003). In addition, researchers rarely have control over which cetaceans are observed or identified (whale watchers usually go back to the same areas and therefore researchers have a restricted 'view' of the population), how much time is spent in proximity to certain animals, and how the vessel is manoeuvred around the whales. This lack of control precludes many types of behavioural studies.

Whale watching may also contribute to the conservation of whales by what is sometimes referred to as the "the great orca trade-off" (Hoyt, 2003). These are the cases where whale and dolphin species had some anthropogenic pressure (habitat reduction, hunting or other pressure) eased on them, in one way or another, because of the spread of whale watching over the past few decades. It is a fact that whales are now worth more alive than dead and overall whale watching is a more profitable industry than whaling (Hoyt and Hvenegaard, 2002). It is estimated that whale watching today generates more than $1 billion US a year worldwide, while by contrast the killing of whales only produces around $50 million US in global annual revenue (Bird, 2003).

The IWC has recognised that whale watching is a form of non-lethal utilisation of whales, and with a 1994 resolution it encouraged the further development of whale watching as a sustainable use of cetacean resources (IWC, 1994). In some countries, in which traditional whaling occurred not long ago, a transformation from consumptive to non-consumptive utilization of cetaceans has occurred, often carried out by the same individuals on the same populations of cetaceans (Neves-Graca, 2002; Orams and Forestell, year not reported).

In other countries, such as Japan, Norway, a few places in the Caribbean, and Iceland, whales may be subjected to both whaling and whale watching. Engagement in these two activities is apparently contradictory and is currently under hot debate (e.g., Ris, 1993; Papastavrou, 1996; Orams, 2001; Hoyt and Hvenegaard, 2002; Parsons and Rawles, 2003). Contentious issues include: reductions in the number of whales available for watching, behavioural changes and disturbance to the animals, differing revenues resulting from the two activities, and negative attitudes of whale watchers and host communities towards whaling (Hoyt and Hvenegaard, 2002).

This chapter has provided a brief introduction to some general knowledge on cetaceans and to the evolving 'relationship' (interactions and management of interactions) between cetaceans and humans. Chapter 2 will explore whale watching as an eco-tourist activity, along with the possibility that whale watching impacts cetaceans negatively, and it will conclude by introducing the rationale for this thesis.

Chapter 2 - Can whale watching be considered a successful form of eco-tourism?

Commercial whale watching is generally depicted as an 'eco-tourist' activity and tour boat operators tend to use this claim to market their industry as 'green'. Despite this claim, however, there is little proof that whale watching can be considered a sustainable, 'non-consumptive' activity with low impact on nature.

In order to analyse this aspect of whale watching, I will provide definitions of eco-tourism and will explore the current debate around this activity. I will then discuss whether whale watching meets the main criteria of a successful eco-tourist activity by considering in detail the core issues of 'flag species', sustainability, educational value, and proper management.

2.1 Defining eco-tourism

Eco-tourism encompasses a wide variety of enterprises ranging from low impact activities such as hiking wetland trails (Meric and Hunt, 1998) to energy-intensive activities such as underwater hotels, tourist submarines and underwater observatories (Cater, 2003). Other activities considered to be eco-tourism include: bird and whale watching, swimming with wild animals, scuba-diving, canoeing, kayaking, camping, tropical forest walks, visiting park and natural reserves, sea cruises to remote areas such as Antarctica or the Arctic, and taking part in research projects that benefit nature (Diamantis, 1999; Buckley, 2004).

The concept of integrating tourism with conservation was introduced in the 1970s (Budowsky, 1976). The term 'eco-tourism', however, came into use in the 1980s, and at first did not imply any commitment towards conservation. It represented instead a reaction against mass-tourism, with a certain 'off-the-beaten path' allure. An early definition of eco-tourism is provided by Ceballos-Lascurain (1987):

"Tourism that consists of travelling to relatively undisturbed or uncontaminated natural areas with the specific objective of studying, admiring and enjoying the scenery and its wild plants and animals, as well as any existing cultural manifestations."

This definition placed eco-tourism in the realm of nature-based tourism (a variety of ways for people to enjoy nature), but it was not until more recently that conservation began to be considered as an integral part of eco-tourism. For example, Valentine (1992) stressed that eco-tourism should: 1) be based upon relatively undisturbed natural areas; 2) be non-damaging, non-degrading; 3) contribute to the protection of the protected areas used; and 4) be subject to appropriate management.

Some definitions also require that the eco-tourist take an active and responsible role and contribute to the quality of the environment. Ziffer (1989), for one, declared:

"The eco-tourist practises a non-consumptive use of wildlife and natural resources and contributes to the visited area through labour or financial means aimed at directly benefiting the conservation of the site."

Garrod (2003) has reviewed definitions of eco-tourism and, while they vary in length and specificity, most of them emphasise commitments to conservation. The Quebec Declaration on Eco-tourism (UNEP, 2002a), for example, states that:

> *"Eco-tourism is environmentally responsible travel that contributes to conservation of biodiversity, sustains the well-being of local people, stresses local involvement, includes learning experiences for tourists, involves responsible action on the part of tourist and tourism industry, and requires the lowest possible consumption of non-renewable resources."*

Many countries are facing the dilemma of trying to conserve nature, while at the same time still achieving short-term economic gains (McNeely *et al.*, 1990; Myers *et al.*, 2000). Eco-tourism seems to be the perfect solution as it generates much needed foreign currency, both locally and nationally, while providing a strong incentive to manage nature's bounties in a manner that conserves them.

Eco-tourism is sometimes seen as a panacea for the protection of nature (Gossling, 1999). In some cases it has been shown that eco-tourism can indeed provide benefits to conservation. For example, revenues that visitors pay to enter Rwanda's Parc des Volcans have allowed the government to create anti-poaching patrols and employ local farmers as park guides and guards, saving the mountain gorillas (*Gorilla gorilla beringei*) of Rwanda from extinction (UNESCO, year not reported). Other examples of beneficial impacts are the preservation of Asian elephant (*Elephas indicus)* habitats in Thailand (Dixon and Sherman, 1990), the protection of wildlands on Mount Kinju in South Korea (Lee *et al.*, 1998), and the preservation of Costa Rican rainforest (Farrell, 1992).

A different kind of benefit is the direct contribution that eco-tourists make by taking part in field research projects. This helps organisations such as the Tethys Research Institute (www.tethys.org) and the Earthwatch Institute (www.earthwatch.org) that fuel research with eco-tourist fees and benefit from their labour as research assistants.

Eco-tourism is now big business, with millions of people taking part in it every year. It is estimated that in 1999, global eco-tourism expenditures were between $10 and $17.5 billion US (Fennel, 1999). According to Hughes (2001), the success of eco-tourism involves the increasing propensity for travel as a "life-enriching experience", generally taking place in the outdoors and particularly learning about nature. Increasing media coverage of environmental issues may also be contributing to a changing attitude towards the environment.

The growth in the numbers of people taking part in eco-tourist activities has been correlated with a shift from an expert-specialist activity (few people, remote area) to a novice-generalist one (more people, more accessible areas) (based on the definitions by Duffus and Dearden, 1990). The same authors also noted that the original concept of visiting wild remote areas has been slowly replaced by more comfortable ways of experiencing nature. Indeed, eco-tourism now seems to have strayed from its original definition as an alternative form of tourism; judging by the numbers, it has become a new form of mass tourism itself.

There is now concern that this increased attention of tourists towards nature may have negative effects, endangering the very resources it relies upon. Impacts of eco-tourism reported in the literature include: disturbance to animals, driving them off preserves, impacting marine habitat with shore facilities, removing the flora, deforestation, pollution, and encroachment on indigenous cultures (Czech and Krausman, 1997; Wang and Miko, 1997; Roberts, 1998; Newsome *et al.*, 2002; Buckley, 2004).

These studies support the idea that eco-tourism can provide only limited benefits to conservation because of its tendency to contribute directly to environmental degradation. According to Isaacs (2000), this is because eco-tourism operates within a market system that holds efficiency as its goal, is based on competition and consumption, and frequently produces negative externalities (e.g., animal disturbance, habitat degradation). According to economic theory, incentives to ignore these negative external costs are very strong. In an economy-driven environment (without legal or moral constraints), it is rational to impose costs on a third party (the natural resource) when it benefits self-interest.

A recent meta-analysis of eco-tourist activities revealed that out of 251 cases studied, only 63% of them could be referred to as ecologically sustainable (i.e. "current practice does not pose a risk to the area or species in the foreseeable future"; Kruger, 2005). The main reasons for the lack of sustainability were: too many tourists (37%), lack of local involvement (28%), lack of management (15%), insufficient local revenue (10%), priorities of the protected area over those of local people (7%) and lack of environmental education for locals (3%). In only 17% of cases was there a positive effect towards the conservation of the species or area targeted. In the same study it was noted that the two strongest factors for predicting sustainability and successful eco-tourist activity were the flagship species and the extent of local involvement.

The apparent contradiction between conserving nature and maintaining profits is not an easy one to resolve, but the presence of negative effects does not necessarily mean that eco-tourism is wholly detrimental. In order to limit negative effects and minimise external costs, governments should adopt and enforce regulations, entrepreneurs should recognise that responsible eco-tourism can be a profitable activity, and individual entrepreneurs and tourists should comply with its principles (Isaacs, 2000).

2.2 Whales as flagship species

One major component in eco-tourism that attracts tourists is a flagship species (Leader-Williams, 2002). If animals are too shy, non-attractive, easily scared away or too sparsely populated, the market for eco-tourism is severely limited (Munn, 1992).

It has been shown that the proportion of sustainable eco-tourism examples is quite low for projects lacking a real flagship species. In contrast, projects involving three flagship species categories, namely, charismatic bird (e.g. penguins and parrots), charismatic mammal (e.g. bears and wolves), and worldwide flagship (e.g. primates and whales), had higher than average probabilities of being sustainable (Kruger, 2005; categories are his). An ideal flagship species must be readily accessible, easy to see, and charismatic to the visitors. Based on these criteria, whale watching seems to target ideal flagship species.

Firstly, populations of whales are present in all of the oceans. With the exception of some species (such as beaked whales or pelagic dolphins such as hourglass dolphins

Lagenorhinchus crucifer), populations of most species of cetaceans spend at least part of their lifecycle in coastal waters and are therefore accessible for whale watching. Coastline habitats are particularly attractive to cetaceans due to the fact that these are usually highly productive areas (Polunin, 1993) and frequently have warm and sheltered waters suitable for breeding and calving (Corkeron and Conner, 1999). Human urbanization favours coasts, with nearly 40% of the human population living within 60 km of the sea (UNEP, 2002b), indicating that a large number of people have potentially easy access to whales (Jefferson *et al.*, 1993).

Secondly, tour boat operators choose sites that afford a high probability of seeing whales, so much so that some enterprises even guarantee encounters with the animals during certain times of the year (personal observation). Commercial whale watching is usually conducted by experienced skippers who have knowledge of the animals' life history, use fast vessels, concentrate on animals in high density areas or in special habitat, and target the more acrobatic, larger or more visible species. Tour boat operators often make use of different searching aids such as echo-sounders, spotters on high cliffs or support airplanes. The common practise of reporting the locations of last sightings to other skippers and the use of Global Positioning System (GPS) make it easier to find whales: the same animals are often observed throughout the day by various vessels.

Thirdly, cetaceans seem to hold some kind of intrinsic fascination for humans and have done so since ancient times (Nolman, 1999). Kalland (1993) suggests that: "whales form an anomalous category of animals, one that does not fit into our simple categories of fish or mammals, thereby becoming objects of myths and taboos." Moreover, whales have recently acquired a particular place in Western popular culture (Lawrence and Nelson, 2004). This is because of their perceived intelligence, the complexity of their life history, the coverage given to them in media and literature, and perhaps due to the special emphasis they were given in the conservation movements of the 1980s when the 'save-the-whale' campaigns brought them to prominence (Forestell, 2002).

2.3 Watching the whales: impact of eco-tourism on cetaceans

The recent expansion of whale watching and increasing demands by tourists for close-up interactions may lead to cumulative, rather than acute, negative effects on natural populations (Duffus and Dearden, 1990; Constantine, 1999; Bejder and Samuels, 2003). Studies show that animals sought out for prolonged, close-up encounters, and/or approached by numerous vessels with erratic paths often react to the presence of tourists by changing behaviour, avoidance or aggression, and/or abandoning an area (Corkeron, 1995; Blane and Jaakson, 1995; Trites and Bain, 2000; Williams *et al.*, 2002a; Courbis, 2004; Lusseau, 2004). There is now concern that repeated disruption of cetacean behaviour may lead to impairments in breeding, social, feeding and resting behaviour, possibly contributing to secondary deleterious effects on reproductive success, health, distribution or access to preferred habitat (Evans, 1996; Fair and Becker, 2000; Frohoff, 2001; Lien, 2001; Bejder and Samuels, 2003; Higham and Lusseau, 2004).

In order to evaluate the extent of these impacts on cetacean populations, I will first identify the potential hazards that whale watching poses to cetaceans. I will then discuss the risks for natural populations. Finally I will discuss whether or not the current level of whale watching is sustainable.

2.3.1 Evaluating the hazards

2.3.1.1 Collisions with boats

Tourism has on rare occasions been directly linked to whale fatalities through collisions with boats (Johnson, 2005). Collisions with recreational motorboats causing serious injury to northern resident killer whales have been reported in British Columbia (Ford *et al.*, 1994). There are more reports of commercial whale-watching vessels colliding with humpback, fin and minke whales, but usually the severity of the strike could not be determined (Weinrich, 2001, quoted in Bejder and Samuels, 2003).

Increased incidence of boat strikes involving bottlenose dolphins in Sarasota Bay, Florida have been correlated with periods of higher than average boat traffic (Wells and Scott, 1997). In a population of about 100 bottlenose dolphins, 4% were injured by boat collisions over a period of 13 years. It is possible that the presence of a calf or of body deformities limited the ability of some dolphins to respond to approaching vessels.

Laist *et al.* (2001) used historical records to quantify the frequency of ship strikes on large whales. Although the authors do not include data on whale-watching activities, some of the main findings also apply to vessels used for viewing cetaceans commercially. The authors found that all type and sizes of vessels hit whales, with the most serious and lethal injuries caused by relatively large vessels (80 m or longer). A great majority of strikes happened over or near the continental shelf (also where most whale watching occurs). Vessels travelling at 14 knots or faster were involved in the majority of severe and lethal injuries. It is suggested that for some small populations or population segments these collisions could pose a substantial threat.

2.3.1.2 Short-term impacts of whale watching

Short-term impacts have been recorded in diverse species and locations. These impacts are usually measured by recording immediate reactions, changes in behavioural patterns or vocalisation, and horizontal or vertical avoidance.

Increased levels of aerial activity in response to approaches by whale-watching vessels have been demonstrated in dusky dolphins (*Lagenorhynchus obscurus*) (Barr, 1997) and in humpback whales (Corkeron, 1995). Increase in aerial activity may occur as an attempt to improve visual and acoustic communication due to the increase in underwater noise with the presence of boats, or as a power display in response to a perceived threat.

Changes in direction and swimming speed of whales in response to approaches of whale-watching vessels have been shown to occur in bottlenose and common dolphins (Constantine, 1995) and in fin whales (Edds and Macfarlane, 1987). Fin whales responded to boats at distances of one kilometre and changed their path of travel to increase the distance between themselves and the vessels. Beluga whales responded to whale-watching vessels by increasing their swimming speed (Blane and Jaakson, 1995). Movements and speed of killer whales were affected by whale-watching vessel approaches within 400 m (Kruse, 1991).

Respiratory parameters were also influenced by approaches of whale-watching vessels. In the presence of vessels, sperm whales showed shorter respiratory intervals and decreased surface intervals (MacGibbon, 1991). These whales also submerged without fluking, had shorter diving times, and increased the time between fluking and first click when whale-watching boats were present (Gordon *et al.*, 1992; Richter *et al.*, 2001). When followed by whale-watching boats, humpback whales showed greater variance in the time spent at the surface and in the number of blows per surfacing (Peterson, 2001). Fin whales reduced dive duration, surface duration and number of blows when whale-watch vessels were nearby (Stone *et al.*, 1992).

Behavioural statuses and budgets can be affected by the presence of whale-watching boats. Killer whales in Robson Bight–Michael Bigg Ecological Reserve, BC, Canada, rubbed their bodies against the pebbles in the so-called ‘rubbing beaches’ for shorter periods of time than normal, left the beaches without performing this behaviour, or simply swam past the beaches without stopping when whale-watching boats were present (Briggs, 1991). Socializing and resting behaviors of bottlenose dolphins were also disrupted by the presence of whale-watching vessels (Lusseau, 2003a).

Boat number, boat type and manoeuvring, and failure to comply with whale-watching regulations have been shown to affect whale behaviour. Resting behavior of bottlenose dolphins decreased as the number of tour boats increased (Constantine *et al.*, 2004).

Short-finned pilot whales responded to increasing numbers of whale-watching vessels by actively avoiding them; when three or more vessels were present the whales showed the strongest reactions (Glen and Butler, 2003). The intensity of response of beluga whales to vessels likewise increased as the number of boats increased (Blane and Jaakson, 1995).

In some cases, whale-watching vessels seem to have a higher impact on cetaceans than do other kinds of boat activity, probably because these boats specifically target whales for longer periods of time and also manoeuvre to stay in close contact with them. Bottlenose dolphins rested less and engaged in more milling behaviour (i.e. frequent changes in heading) when approached by permitted boats as compared to non-permitted boats (Constantine *et al.*, 2004). The same species also showed a significant decrease in the number of surfacings when approached by commercial boats, a change that did not occur with other kinds of boat traffic such as fishing boats or motor yachts (Janik and Thompson, 1996).

Observations on boat approaches have shown that whales may be sensitive to the way vessels are manoeuvred. Southern right whales generally moved away from boats that circled them or approached them head on (Campagna *et al.*, 1995), but appeared tolerant of whale-watching traffic when boats were handled in agreement with the national legislation (Groch *et al.*, 2003). Responses of humpback whales to tour boats in Ecuador increased when whale-watching guidelines were violated (i.e. boats came too close, performed high-speed or wrong-side approaches, and/or overtook the group; Felix, 2001).

2.3.1.3 Long-term impacts of whale watching

There are only a few studies on the long-term effects of whale watching on cetaceans. Long-term impacts are usually measured by recording changes in range, habitat use or distribution. Links between whale watching and long-term effects are often speculative.

Bottlenose dolphins reduced the use of certain habitats during periods of greater tourism and higher whale-watching vessel presence (Samuels *et al.*, 2004). The same animals appeared to avoid an area altogether when whale-watching traffic was too intense (Lusseau, 2004; 2005). Dusky dolphins moved up to 30 miles away from both organized tourism and a high concentration of private boats, but such shifts could also be due to changes in ecology, including differences in night food distribution (Würsig and Würsig, 2003).

One study showed a possible long-term effect of whale watching on baleen whales. During the period 1991-1994, grey whales moved 20 km further away from the main commercial whale-watching port of Tofino, BC, Canada. It was found that only 25-50% of photo-identified animals returned to the area. A mixture of ecological and human influences may have affected the whales' use of the area (Duffus, 1996).

2.3.1.4 Experimental impacts on cetaceans

Impacts of eco-tourism on cetaceans have also been studied using experimental boat approaches to whales. Bottlenose dolphins changed orientation away from the path of approaching boats, and increased swimming speed and group cohesion during vessel approaches (Nowacek *et al.*, 2001). Increased group cohesion was considered a measure of disturbance under the presumption that animals bunch together in situations of surprise, threat or danger (Johnson and Norris, 1986).

Fin whales responded to experimental boat approaches with two simultaneous avoidance strategies: increased velocity and reduction of time spent at the surface. Feeding fin whales also changed their behavior and began to travel. Pre-disturbance behaviour did not resume within the one-hour post-interaction follow up (Jahoda *et al.*, 2003).

Controlled vessel approaches affected whale acoustic behaviour. Decreased rates of whistles and of echolocation clicks in bottlenose dolphins were found during boat approaches and immediately after boat departures (Lemon *et al.*, 2003). Longer call duration, changes in calling rates, an upward shift in the frequency range, and a tendency to emit calls repetitively were found in belugas approached by experimental vessels (Lesage *et al.*, 1999). Responses to the larger and slower vessels were more persistent. Vocal responses may have been strategies to enhance signal detection to compensate for acoustic masking (Lesage *et al.*, 1999).

Killer whales responded to experimental boat approaches by adopting a less predictable path (Williams *et al.*, 2002a). In a similar study, male killer whales responded with more tortuous paths to 'leapfrogging' vessels. This practice consists of speeding ahead of whales and positioning the vessel in their path, also resulting in increased levels of sound in the water (Williams *et al.*, 2002b). Leapfrogging is discouraged by some whale-watching guidelines, such as those in British Columbia, Canada (Williams *et al.*, 2002b).

2.3.1.5 Impact of noise on cetaceans

Cetaceans have evolved to rely heavily upon sound for many functions necessary for their survival and reproduction (Elsner, 2002). In recent times, coastal urbanization and increased human activities in the oceans have raised the level of man-made noise in this environment (Perry, 1998). The main sources of anthropogenic noise in the ocean derive from boat traffic, aircrafts, industrial and military activities, seismic exploration, sonar, acoustic thermography and acoustic deterrents.

Evidence indicates that anthropogenic noise may exert behavioural and physiological effects on cetaceans, including: disruption of normal behaviour (Richardson *et al.*, 1985; Evans *et al.*, 1992; Janik and Thompson, 1996; Todd *et al.*, 1996; Lesage *et al.*, 1999), hearing impairment (Ketten *et al.*, 1993; Taylor *et al.*, 1997), masking of calls (Au and Green, 2000; Erbe, 2002), physical damage (Ketten *et al.*, 1993; Richardson *et al.*, 1995), and displacement (Borggaard *et al.*, 1999). In some cases the effects of noise have been linked to mass strandings (Hall, 1996; Simmonds and Mayer, 1997; Frantzis, 1998; Fernandez *et al.*, 2005).

Reaction thresholds tend to be lower for pulses than for continuous noises and lower for moving, or erratic signals than for stationary ones (Watkins, 1986; Richardson, 1997). By comparing the level of underwater acoustic noise of whale-watching boats with that of humpback whale vocalizations, studies have shown that this source of anthropogenic noise is unlikely to cause long-term harm to the whale auditory system (Au and Green, 2000). However, masking of whale sounds and disturbance are possible. An acoustic impact model showed that whale-watching boats produced sounds audible to killer whales at over 16 km and were capable of masking killer whale calls at over 14 km (Erbe, 2002). The same sound could elicit a behavioural response at over 200 m and could cause a temporary threshold shift in hearing of 5 dB after 30-50 min within 450 m. The masking effect was found to be strongest when both the test signal and the noise source were located directly in front of the killer whales (Szymanski *et al.*, 1999).

A linear relationship between noise level and speed of vessels has been found and rapid increases in noise elicited the highest responses in humpback whales (McCauley and Cato, 2001). In the same study, it was shown that vessels that by design required constant maneuvering to maintain station produced greater adverse responses from these whales. Studies have shown that the sound of icebreakers is audible to belugas at distances of 60 km and that these whales show avoidance behaviour at distances of 40 km (Erbe, 1997).

Startle responses (i.e. involuntary reactions to a sudden stimulus involving skeletal muscle and visceral reactions) to vessel noise emissions have also been documented, suggesting that sometimes, quieter boats, traveling at high speed, may disturb whales more than slower, larger boats that emit higher intensity noise (Evans *et al.*, 1992).

Experiments to investigate the reaction of whales to playbacks of man-made sounds have been performed. Humpback whales showed increased distance and time between successive surfacings during playbacks of low frequency sounds utilized for acoustic thermometry of ocean climate (Frankel and Clark, 1998). These sounds exceeded 120 dB re: 1 μ–Pa, with a source signal as an M-sequence centered at 75 Hz with a 30-Hz bandwidth. However no difference in whale tracks or bearings between control and playback conditions were found. Grey whales 'startled' at the sudden onset of noise during playback of sound levels exceeding 120 dB in studies associated with ships and seismic explorations (Moore and Clarke, 2002).

In Trinity Bay, Newfoundland, a monitoring program was started after reports of high entrapment rates in fishing gear of humpback whales coincided with the onset of industrial activities (Lien, 1991). Although no overt behavioural reactions to drilling and underwater explosions were noticed (Todd *et al.*, 1996), two humpback whales were found dead with evidence of ear trauma consistent with blast injury in humans (Ketten *et al.*, 1993). A subsequent study showed that identified individual animals were also less likely to be re-sighted near the dredging areas (Borggaard *et al.*, 1999).

2.3.1.6 Impact of boat traffic on cetaceans

The impact of commercial and recreational boat traffic on cetaceans has been studied for different species and locales. These activities, although not directed towards cetaceans, have been shown to influence whale behaviour. Speed, size, distance and number of vessels all affected whale responses (Baker and Herman, 1989). Boat traffic was found, for example, to increase the breathing synchronicity of bottlenose dolphins, an increase usually interpreted as an anti-predator response (Hastie *et al.*, 2003). Humpback whales showed short-term responses (decreases in blow interval and increases in diving times) to vessels operating at distances of less than 4 km. Bottlenose dolphins showed negative behaviour (moving away, changing direction, and diving for more than 5 minutes) in the presence of fast moving vessels such as speedboats and jet skis (Goodwin and Cotton, 2004). Pacific humpback dolphins (*Sousa chinensis*) increased their rate of whistling immediately after a boat moved through the area (Van Parijs and Corkeron, 2001).

Habitat use and distribution were also influenced by vessel activity. Foraging bottlenose dolphins showed habitat preferences during periods with low vessel activity, but habitat selection was not apparent during periods of high traffic (Wells, 1993; Allen and Read, 2000). High levels of boat traffic did affect the movements of mother/calf humpback pairs in Hawaii (Ferrari, 1988; Salden, 1988; Smultea, 1994) and humpbacks were sighted less often in one area in Maui after tourist operations began there (Green *et al.*, 1999). The failure of humpback whales to reoccupy former whaling grounds may be due to the effect of human development and heavy shipping traffic (Swartz *et al.*, 2003). Increased vessel traffic probably caused reduced usage of Guerrero Negro Lagoon in Baja California by grey whales and of Glacier Bay, Alaska by humpback whales (Bryant *et al.*, 1984; Dean *et al.*, 1985).

2.3.1.7 Impact of swim-with-wild cetacean activities

Swimming with wild cetaceans has been growing in popularity. Most commercial activities target odontocetes, but swimming with mysticetes is also known to occur in the Dominican Republic, Tonga, Costa Rica, Australia, New Zealand, USA, the Canary Islands, and Maldives (Birtles *et al.*, 2002; Rose *et al.*, 2003). Species involved are humpback whales, sperm whales, dwarf minke whales, blue whales, grey whales and others. There are no studies on the effects of swimming with mysticetes.

A few studies are available on the impact of swim-with-dolphin activities, mostly conducted in Australia and New Zealand, where swimming with dolphins is legal, and in the US (mainly in Florida and in Hawaii), where this activity is discouraged by the National Marine Fisheries Service (NMFS), but not technically illegal (Samuels and Bejder, 2004). Swim-with-dolphins activities are also known to occur in Zanzibar, Egypt, Japan, the Canary Islands, the Azores, Israel, and Ireland. Swim-with-dolphin activities can disrupt resting and feeding behavior (Barr, 1997; Würsig *et al.*, 1997), induce dolphins to form more compact groups (Bejder *et al.*, 1999), change dolphin direction of travel, and result in increased activity during normally quiescent periods (Barr and Slooten, 1998; Bejder *et al.*, 1999).

Whales' vocal behaviour can also be influenced by the presence of human swimmers. Increased emissions of high intensity, stress-related sounds and 'freeze' responses have been documented (Helweg, 1995). Increases in whistle production, probably to maintain group cohesion, have also been found (Solker and Pepper, 1999; Scarpaci *et al.*, 2000).

Approach strategy for swimmer placement significantly affects dolphins' responses. The highest rate of avoidance behaviour was observed when operators drove past bottlenose dolphins and veered into their path of travel (an illegal 'J' manoeuvre according to the Australian regulations) (Weir *et al.*, 1996; Constantine and Baker, 1997; Scarpaci *et al.*, 2003). The impact of swimmers entering the water from the beach was found to be less than that of vessels (Bejder, 1997). In another location, however, where swimmers and kayakers reach resting dolphins from shore, increased tourist presence was considered to be the most probable cause of a 21% decrease of shallow bay usage by spinner dolphins (Forest, 2000). Long-term studies also show that, with cumulative experience, dolphins seem to become sensitised to swim attempts (Constantine, 2001).

2.3.1.8 Impact of feed-the-dolphin activities

Feed-the-dolphin activities are known to occur in various countries around the world, although not in Canada; in certain places, including the US, this practice is illegal. It is, in fact, believed that feeding wild animals alters their natural behaviour and poses risks to the animals by changing their habitat use, calf-rearing abilities, and loss of wariness to humans (MMC, 1994).

Nevertheless, illegal tours to feed the dolphins, harassment of dolphins, and aggressive incidents by dolphins towards humans were still reported in the US in 1997 (Seideman, 1997). In a few cases, individual dolphins had become dependent on handouts from humans and would beg for fish and often become aggressive towards humans if not given any. Some people attempted to feed dolphins beer, pretzels and hooks baited with fish. In Florida this activity put a specific juvenile dolphin at risk once every 12 minutes, while humans interacting with that dolphin were estimated to be at risk once every 29 minutes (Samuels and Bejder, 2004).

Illegal feeding of the Indo-Pacific humpback dolphins, a protected species, is known to occur in Australia (Samuels *et al.*, 2000), where provisioned bottlenose dolphins also have become more aggressive and 'pushy' (Orams *et al.*, 1996). Increases in begging behaviour and bait stealing have likewise been reported (Wilson, 1994). Long-term studies have shown that the survival rate of bottlenose dolphin infants has been decreasing, possibly because of the reduced nursing opportunities that mothers and calves have when they are in the provisioning area (Mann *et al.*, 2000; Mann and Kemps, 2003).

2.3.1.9 Impact of whale watching on solitary cetaceans

Targeted viewing and swimming with lone, sociable dolphins is rare, but there are places where one solitary dolphin has been the main focus of eco-tourists. For example in Dingle, Ireland, a dolphin called Fungie has been attracting hundreds of thousands of people for the last 20 years. He is the longest-standing friendly solitary dolphin in the world. It has been estimated that the presence of Fungie contributed over $10 million US (including indirect effects) to the local economy (Timmins, 2003).

Although solitary sociable dolphins can be a good source of eco-tourist revenue, recent studies have shown that habituation to humans can be problematic, both for humans and for the dolphins. Dolphins can have periods of misdirected sexual behavior towards humans, buoys, and/or vessels, cause damage to human property (primarily vessels and fishing gear), and create conflict with locals (Samuels *et al.*, 2000). Dolphin-to-human aggression has at times resulted in serious human injury, such as a ruptured spleen, broken ribs, or even death (Perrine, 1990; Santos, 1997).

Further, habituation to people put these animals at higher risk of injury and human aggression. A lone, sociable dolphin in Brazil was grabbed, hit, and jumped on, and some bathers tried to put ice cream sticks into its blowhole (Santos, 1997). At least four lone, sociable dolphins were intentionally killed, and there have been many suspicious disappearances of sociable dolphins (Frohoff, 2001). Although some of these interactions had serious consequences for the individual dolphins, the impact on the populations is likely to be negligible (Lien, 2001).

2.3.2. Evaluating the risks

2.3.2.1 Stress and cetacean welfare

Stress is "the biological consequence of exposure to adverse environments" (Selye, 1976). In the most accepted model of stress, a pathological state is usually pre-announced by a variety of abnormalities and inadequacies in behaviour, physiology, immuno-system function and reproduction (Moberg, 1985a). Stress may diminish 'welfare' (defined by Broom and Johnson, 1993, as "the state of an organism as regards its attempts to cope with its environment"), but have no impact on animal fitness if an animal manages to cope effectively. On the other hand, if an animal is unable to cope, fitness may be impaired and essential life history processes such as feeding, socialising, migrating, reproducing, and caring for the young may be at risk (Moberg, 1985b).

The perception of an external threat, whether it is a social interaction with a peer, the experience of pain or the exposure to an unknown stimulus, depends on the central nervous system (Dierauf, 1990). This system assesses whether a stimulus or a group of stimuli represents a significant challenge for the animal; this assessment will depend on individual variability and experience, environmental conditions, nutritional, social and reproductive status and more.

If the stimulus is perceived as threatening, animals rely on three major biological systems to cope. For most challenges, the simplest and frequently the most economical response for the animal is to alter its behaviour and simply remove itself from the threat (GBRMPA, 2000).

A further step is the activation of the autonomic system, which is known as the flight-fight response (Cannon, 1929). A release of catecholamines dramatically increases heart rate, blood pressure, and metabolism, thereby enabling the animal to make quick physiological adjustments in response to acute stress.

The final step is the activation of the hypothalamic-pituitary-adrenal cortex axis, with releases of corticosteroid hormones (Lee Kirby, 1990). This further redirects the body's biological machinery to provide necessary resources to help maintain homeostasis during stress, through mobilisation of proteins and lipid reserves.

It is now believed that long-term stress and sequential prolonged secretion of corticosteroids may have negative impacts on the well-being of the animal due to immuno-suppressive effects (Norman and Litwack, 1997). There is copious evidence in the literature showing the activation of the neuroendocrine response in animals exposed to stress, including rats (Riley, 1981; Dhabhar, *et al.* 1993), mice (Gamallo *et al.*, 1986, Stark *et al.*, 2001), birds (Wingfield and Hunt, 2002; Carere *et al.*, 2003), seals (Bartsh *et al.*, 1991; Sanvito *et al.*, 2004) and monkeys (Van Shaik *et al.*, 1991; Ferin, 1993).

Studies on cetaceans have shown that these animals exhibit a similar stress response (Medway *et al.*, 1970; St. Aubin and Geraci, 1990; St. Aubin *et al.*, 1996; Fair and Becker, 2000). Most of the studies have been performed on captive odontocetes or on temporally restrained wild animals. For example, Thomson and Geraci (1986) evaluated the stress response of wild bottlenose dolphins following capture by different methods. In the case of chase-capture, blood level of cortisol (a corticosteroid hormone) increased from 30 to 110 nmol/L within 1 hour. Measuring physiological stress in mysticetes is usually logistically unfeasible. However, an opportunistic study was performed on a Bryde's whale that was temporarily entrapped in Mannin river, New South Wales, Australia (Priddel and Wheeler, 1998). After 100 days of entrapment the whale showed signs of emaciation, profound catabolism and high levels of stress hormones.

2.3.2.2 Habituation or sensitization?

Habituation is defined as a "gradual weakening of responses to a recurring stimulus that provides no apparent reward or punishment", while *sensitization* is defined as an "increased likelihood that repeated exposure to a particular and significant stimulus will produce a response in an animal" (Allaby, 1999). Some individuals in some species of cetaceans seem to quickly habituate to human presence (even if, typically, wild animals are unlikely to habituate to close approaches, pursuit, or abrupt or unusual human activities). Conversely, some species or some subgroups do not tolerate human presence or habituate to human activities at all and instead move to different locations.

Examples of habituation include the decrease in reaction to traffic of harbour porpoises later in the season (Evans *et al.*, 1993) and diminished reactions to boats by bottlenose dolphins over recent years (Acevedo, 1991). Southern resident killer whales now seem more accustomed to the presence of whale-watching boats and more tolerant to close approaches than in the past (Phillips and Baird, 1993; Felleman *et al.*, 1998).

Sensitization of cetaceans to whale-watching activities can also occur. Hector's dolphins avoided tourist vessels if encounters lasted more than 70 minutes (Bejder *et al.*, 1999). Bottlenose dolphins increased avoidance to swimmers over a 4-year period (Constantine, 2001). Avoidance of vessel traffic lasted longer for a river population of Irrawaddy dolphins that was chronically exposed to traffic than for a coastal population that was less exposed (Kreb and Rahadi, 2004).

2.3.2.3 Individual and group susceptibility to impact

Several factors may enhance or reduce the susceptibility of individual whales to human impact. It is now known that species, gender, age, reproductive condition, and individual or population variability, either singly or in combination may influence how individual whales respond to anthropogenic activity (Bejder and Samuels, 2003).

Different species are known to react differently to human activities. For example, in the same location off Cape Cod, over a 25-year period, minke whales' initial interest in vessels dampened into generally uninterested responses, while humpback whales' frequently negative responses changed to often strongly interested or positive responses (Watkins, 1986). In the same place, fin whales changed from negative to uninterested, while right whales did not show any substantial change (Watkins, 1986).

Male and female killer whales used subtly different strategies to avoid whale-watching vessels. Females responded by swimming faster and increasing the angle between successive dives, whereas males maintained their speed and chose a smooth, but less direct path (Williams *et al.*, 2002a). Male bottlenose dolphins started avoiding boats as soon as they were present, while females switched to a vertical avoidance strategy only when interactions became intrusive (Lusseau, 2003b).

Reproductive condition and age also influence susceptibility of cetaceans to human impacts. Pods of early migrating grey whales (likely containing pregnant females) reacted differently to tour boats than did pods that migrated later in the season (Schwarz *et al.*, 2003). Groups of Indo-Pacific humpback dolphins that included mother–calf pairs had a higher increase in whistles in response to boat passages as compared to groups with no calves (Van Parijs and Corkeron, 2001). Inexperienced bottlenose dolphin mothers were more prone to vessel strikes than older mothers (Wells and Scott, 1997). Humpback whale mother-calf pairs were highly susceptible to disturbance during whale-watching encounters (Felix, 2001); this was found to be more so in the breeding ground than in the feeding grounds, probably due to the different age of the calf (Lester *et al.*, 2003). Cetaceans generally are found to be more susceptible to disturbance when resting than when engaged in feeding or mating (Watkins, 1986; Richardson and Würsig, 1997).

Reactions to human presence also vary with individual animals and their previous experiences with human activities. In response to the same sonar emission, some humpback whales ceased to sing, others increased the duration of songs, and others did not give any apparent response (Miller *et al.*, 2000). Individual sperm whales responded differently to whale-watching vessels (Gordon *et al.*, 1992). This was the case with grey whales also, as some individuals changed course and demonstrated altered swimming speeds and respiratory patterns, while others swam directly towards the boats (Moore and Clarke, 2002). Juvenile (inexperienced) bottlenose dolphins were more likely to interact with human swimmers and were therefore at higher risk for harassment than were adults (Constantine, 2001).

Many individual whales, groups or populations exhibit fidelity both within and between years to specific areas and the impact of whale watching may be disproportional on a few individuals or special groups of whales that are therefore more vulnerable to long-term impacts (Clapham *et al.*, 1993a). This has been shown for resident sperm whales of Kaikura, New Zealand (Richter *et al.*, 2001) and resident killer whales in British Columbia, Canada (Felleman *et al.*, 1998).

2.3.2.4 Sustainability of cetacean populations subject to whale watching

It has now been outlined that whale watching can exert an effect on cetaceans. Short-term effects such as changes in behaviour, increased diving times, increase or decrease in vocalisation, increased aerial behaviour, increased swim synchronisation, changes in swim speed and orientation have all been documented. Moreover, boat handling practices, numbers and proximity of boats, presence of swimmers in the water, presence of high levels of noise, and other factors have been shown to influence cetacean behaviour. Data on long-term effects are generally lacking, but it is known that cetaceans can be displaced from areas with high human presence.

It has rarely been possible to demonstrate links between short- and long-term disturbances and impairment in animal fitness, survival rates and population sizes. This is due to multiple factors. To begin with, there is a general lack of studies that set out to measure long-term effects on populations. Secondly, difficulties arise in distinguishing the effects of human activity from long-term changes resulting from ecological factors. For most cetacean species there is also a lack of baseline data from undisturbed areas to be used for comparative analysis. Finally, there is a general lack of knowledge on population numbers and carrying capacity, especially for species heavily exploited by whaling. Even considering these uncertainties, however, there is still concern that eco-tourism activity may have serious impact on cetacean populations.

First of all, some cetaceans have been shown to begin evasive behaviour at large distances (Au and Perryman, 1982). Thus, the most susceptible animals may already have fled the area when vessels arrive and therefore are never studied (Salvadó *et al.*, 1992; Constantine, 1995). Secondly, some species of cetaceans depend on specific areas for feeding, breeding, calving and socializing; these areas usually become well known and targeted for whale-watching activities, thereby increasing the animals' vulnerability to repeated disturbance in important areas, with a greater likelihood of conservation consequences (Felleman *et al.*, 1998; Richter *et al.*, 2001). Thirdly, the impact on some individuals or segments of the population such as resident animals, calving animals or mother-calf pairs may be disproportional (Wells and Scott, 1997; Lester *et al.*, 2003).

So far, there is no direct proof that whale watching has irremediably impacted the survival of any cetacean population. However, short-term responses are occurring and cetaceans leave an area if disturbance is too intense or too protracted in time (Bejder *et al.,* 2006). The biological significance of such changes is hard to define, but cetaceans have shown to be susceptible to stress if exposed to adverse stimuli, especially if these are long-term. In evolutionary terms, exposure to commercial whale watching is a novelty, and thus a possible stressor.

Future consequences are not known, but some cetaceans could be unprepared to cope, given that, in some cases, signs of sensitization have been demonstrated. Moreover, whale watching is only one of the threats that cetaceans face in present-day oceans. Some populations that are already at risk as a result of direct past exploitation or other current anthropogenic threats may not be capable of sustaining the additional burden of eco-tourism.

2.4 The educational value of whale watching

"Whale watching can serve a valuable function in increasing the public's appreciation and knowledge of marine mammals and their commitment to whale conservation" (Tilt, 1987). According to Hoyt (2002): "if you begin to care about individual whales, you start to care about species. Then you pay attention to other species the whale needs for its survival. Soon, the protection of the ocean, the whales' habitat, takes on a new urgency." Other authors report that: "passengers on whale-watching trips usually leave with a greater appreciation of whales, whale conservation and the overall marine environment" (Beach and Weinrich, 1989). Finally, "a public that loves whales, and understands what their personal impact can be on the animals is, or could be, the best protection for the animals" (Lien, 2001). In agreement with this general consensus, international organizations such as the IWC officially noted that: "all whale watching should contain an educational component adhering to a high standard of quality" (IWC, 1997). In the same year, the International Fund for Animal Welfare (IFAW, 1997a) held an international workshop on the educational benefits of whale watching. Table 2.1 presents some of the main educational values that were assigned to whale watching by the participants of the workshop.

Table 2.1: The educational values of whale watching (IFAW, 1997a).

	EDUCATIONAL VALUES OF WHALE WATCHING
1.	Whales are emblems for promoting awareness of endangered species and habitat protection.
2.	Whale watching provides the opportunity for people across ages and cultures to become familiar with environmental issues and to become involved in conservation efforts on a personal, local, regional, national and international level.
3.	The development of education programs forges links between the whale-watching industry and the local communities as well as building bridges between the general public and scientific community.
4.	Natural history knowledge gained through whale watching has intrinsic value.
5.	Whale watching provides an opportunity to observe animals in the wild, transmitting factual information and dispelling myths.
6.	Whale watching is a model for marine educational programs in adventure travel and eco-tourism.
7.	Whale watching provides the opportunity for appreciation and understanding of local history, culture and environment.

Despite this general consensus, so far there has been little scientific research to test how much whale watchers actually learn during their trips and, more importantly, if an increase in knowledge is then followed by attitudinal and behavioural changes (Orams, 1997; Russell, 2002; Malcolm and Duffus, 2003).

2.4.1 Learning, attitude and behavioural changes

The primary goal of environmental education is to encourage people to engage in more pro-environmental behaviour (Leeming *et al.*, 1993). According to Hungerford and Volk (1990), there are three steps leading to environmentally responsible behaviour: 1) entry (environmental sensitivity and knowledge is gained through learning); 2) ownership (a pro-environmental attitude and feelings of personal identification and investment develop); and 3) empowerment (acquisition of relevant strategies and an internal locus of control - i.e., the perceived ability to change oneself and one's environment - make one ready to take action).

Environmental education research has generally shown that the links between learning (i.e., knowledge gain), attitudes, and behaviour are complex (Hines et al. 1987; Forestell, 1990; Orams, 1994; Zelezny 1999; Malcolm and Duffus, 2003). For example, it has been argued that some knowledge must be gained before attitudes are affected (Matthews and Riley, 1995), whereas in one study even when students had little knowledge of marine environments they nevertheless were quite concerned about marine issues and protection of whales (Walter and Lien, 1985). It is not uncommon, furthermore, for specific knowledge to be acquired without corresponding gains in environmental attitudes or behaviours (Beaumont, 2001).

An attitude can be defined as a disposition underlying one's choice of behaviour (Weigel, 1985). Attitudes are considered by social psychologists to consist of three components: cognitive (beliefs, facts, principles, knowledge, or understanding); affective (emotion, feeling, or emotional evaluation); and conative (behavioural tendency or intent) (Weigel, 1985). Changing attitudes, especially of adults, is difficult. It has long been recognised that a majority of individuals' basic attitudes are formed between the ages of seven and twelve (Tourney and Tesconi, 1977).

The possibility of changing environmental behaviour through education is also a complicated matter. Factors that may influence willingness to change are age, sex, education, and experience level. A meta-analysis of educational interventions to increase environmental behaviour showed greater effectiveness with participants 18 years old or younger (Zelezny, 1999). Women and those with higher education levels (Steel, 1996), as well as people with less outdoors experience (Manfredo and Bright, 1991; Beaumont, 2001), have also been found more willing to adopt environmental behaviours.

2.4.2 Issues in environmental education delivery

Traditionally, environmental education has been delivered through the school system (Tamzin, 1996, Zelezny, 1999). There is now consensus, however, that informal learning experiences are generally more effective (Jeffrey-Clay, 1999; Pedretti, 2002). Russell (2001) argues that, "outdoor education can help reduce the fundamental anthropocentrism of traditional schooling." "Environmental education should be performed in informal natural settings" and "should be appreciative in nature rather than consumptive" (Howe and Disinger, 1988; Hampel *et al.*, 1996). Research has shown that experience outdoors may be the single most important influence affecting people's thinking in relation to the environment (Palmer, 1988).

Critiques of the apparent benefits of outdoor environmental education include the fact that people who undertake outdoor activities may already be environmentally inclined and therefore more likely to enter with prior concern for the environment (Townsend, 2003); in other words, one is 'preaching to the converted' (Beaumont, 2001). On the other hand, it is likely that environmental education can still be useful to reinforce relevant concepts for people with prior knowledge, while introducing new concepts and a heightened 'environmental sensitivity' to the novice (Doering, 1992, Beaumont, 2001).

Some advocates of effective environmental education suggest that programs should be devised in order to tap into *cognitive dissonance* and the *affective domain* (Tamzin, 1996; Lee Meinhold, 2003). Cognitive dissonance is defined as a "state of psychological discomfort that motivates the person to seek information (or to act) in an attempt to alleviate the discomfort" (Forestell, 1990; Orams, 1996). The logic is that people who acquire knowledge and come to care about environmental issues would experience cognitive dissonance (i.e., would not have the 'comfort' of seeing themselves as 'good' people) if they did not then act in ways that were environmentally responsible. "The affective domain [i.e. people's emotions and values] provides the bridge between the stimulus and the cognitive and psychomotor aspects of an individual's personality" (Orams, 1994). "Because cetacean-based interactions cause emotional responses in many people, this could be an effective method of prompting learning" (Tamzin, 1996).

Finally, educational initiatives should be delivered in such a way that people feel empowered to do something with their knowledge (Forestell, 1990; Orams, 1996; Russell, 2002). It is essential that participants be given some way of immediately acting on the awareness they have gained (Townsend, 2003) and/or clear strategies to take away with them to follow up on any 'sparked' concerns. It is, after all, "only actual behavioural changes and actions that will ultimately affect the quality of the environment" (Leeming *et al.*, 1993).

2.4.3 Whale watchers

It has been shown that factors including personality variables, attitude, cognitive styles, environmental stimuli, physiological drives and socio-economic status provide individuals with different levels of desire and means to pursue interactions with wildlife (Duffus and Dearden, 1990).

The demographics of whale watchers are similar to those generally reported for tourists engaged in other forms of wildlife viewing. Surveys carried out in various countries around the world showed that whale watchers are typically between the ages of 18 and 45, more than half of them are female, the majority are urban dwellers, they have fairly high education (50% have some post-secondary education), and one quarter have an income over $60,000 US (Duffus, 1988; Forestell and Kaufman, 1990; Neil *et al.*, 1996; Dickson and Benham, 2001; Finkler and Higham, 2004).

The percentage of first timers is usually between 50-60%, but this varies with location (Bierman, 2001; Warburton *et al.*, 2001). Remote and recently discovered areas seem to attract more experienced people, while long established and easily reachable locations are popular with novices (Duffus and Dearden, 1990). Experienced whale watchers are usually characterized by high *a priori* knowledge, prior involvement in conservation issues, and higher levels of organization (e.g., carrying high quality equipment, such as binoculars, cameras and lenses, video cameras, field guides, and more).

2.4.3.1 Expectations and preferences

An *expectation* is "the belief that a particular outcome will occur or that it can be an anticipated reality" and a *preference* is "a general belief about ideal conditions" (Shelby *et al.*, 1983). Whale watchers could have expectations and preferences relating to: perception of crowding, actual activity, other passengers, weather, education, food, safety, sea sickness, prices, impact on the resources, services, operator, guide quality, duration of the trip, and the proximity, frequency and behaviour of whales (IFAW, 1997a; Finkler and Higham, 2004).

Commercial whale-watching operators often entice customers by portraying distorted ideas of what is acceptable behaviour around wild animals, publicizing activities such as touching animals and close-up encounters, and by using images of spectacular whale behaviour to dramatize advertisements (Orams, 2000). Moreover, media coverage in documentaries, TV programs, and nature magazines often portray animals in appealing close-up shots, spectacular behavioural activities and underwater shots, thereby potentially influencing the expectation levels for tourists going to view whales in the wild (Lee Meinhold, 2003, Malcolm and Duffus, 2003).

A pre-trip survey found that 23% of participants at a swim-with-dolphins operation were fulfilling a lifetime dream and 72% expected to get within zero to two meters of a dolphin (O'Neill and Lee, 2001). Beyond the media, individual history can also influence expectations (Duffus and Dearden, 1993), with, for example, more experienced whale watchers having lower expectations than those going for the first time (Neil *et al.*, 1996).

2.4.3.2 Satisfaction

Expectations and preferences will influence the satisfaction of whale watchers. Passengers' satisfaction is "a function of the discrepancy between what one expected and what one received from the trip" (Manfredo and Bright, 1991). Not surprisingly, studies have shown that whale watchers are the most dissatisfied as a result of not seeing any whales (Duffus, 1988), and that people believe beforehand that they will benefit most from seeing whales as close as possible (Reid, 1999; Birtles *et al*., 2002; Finkler and Higham, 2003).

Other studies revealed, however, that distance from the whales was not a major factor in passenger satisfaction and that, surprisingly, 35% of whale watchers returned satisfied even when no whales were sighted (Orams, 2000). Other factors that contribute to people's satisfaction were the numbers of fellow passengers, cruise duration, boat construction, and seasickness. For many, the most important aspect was the responsible behaviour of the operator around wildlife, followed by encountering the animals and having a naturalist on board (Dickson and Benham, 2001).

2.4.4 Educational outcomes of whale watching

"The obvious obstacle to environmental education for tourists is that their primary motivation is often entertainment and relaxation and that they are a non-captive audience, therefore voluntary and not necessarily attentive" (Townsend, 2003). There is evidence, however, that people do not always see learning and enjoyment as dichotomous variables and that interpretation is highly valued by whale watchers (Neil *et al.*, 1996; Falk *et al.*, 1998).

In three different studies, between 75% and 98% of those interviewed considered the educational component to be an important part of their whale-watching trip (Neil *et al.*, 1996; Reid, 1999; Bierman, 2001). In one survey, 50% of the people reported listening to the entire commentary and 27% listened to most of it (Reid, 1999). In another study, 87% of the passengers would emphasize more conservation and environmental issues if they were the interpreters on the whale-watching trips (Russell, 2002). People taking part in a swim-with-dolphins activity would have liked to learn more about dolphins (34%) and marine life (78%) (Lück, 2003). In the same survey, 95% of the tourists agreed that it was important to learn to care about wildlife during their vacation.

There have been only a handful of studies that tested how much whale-watching passengers actually learned during their experience. Of these, only one clearly demonstrated that this activity could have some educational benefits for the passengers, and only when a structured educational program was in place (Orams, 1997). In this study, participants in a swim-with-dolphin program that were exposed to a pre-encounter briefing with researchers scored higher on a knowledge test than did the non-exposed group. A follow up survey revealed that the exposed group also had a higher percentage of people that took action on environmental issues after the trip.

In another study, tour boat passengers that had gone whale watching before scored higher than beginners in a questionnaire on humpback whale biology (Neil *et al.*, 1996).

This may indicate that previous whale-watching experiences had some long-lasting effects on passenger knowledge or, alternately, that more experienced whale watchers are generally more nature-inclined and therefore more knowledgeable about whales.

In other places, where formal educational programs are lacking, studies have shown that passengers on whale-watching boats do not improve their knowledge (Russell, 2002), and that they also have poor recollection of the information provided during the trip (Malcolm and Duffus, 2003).

An ideal educational program for whale watching should have a positive influence on tourist satisfaction and enjoyment, increase knowledge, change environmental attitudes, create intentions to change behaviour, and promote action (Orams, 1995). The few studies available demonstrate that whale-watching experiences can achieve these objectives only when carefully designed educational programs are incorporated and that current programs offered by tourism operators are seldom structured to promote effective environmental education (Orams, 1997). If the nature-based tourism industry is to make a positive contribution to promoting conservation of the natural environment, operators must adopt new strategies.

One such strategy could be to deliver messages through different media and during different parts of the whale-watching experience. This may include brochures in gift shops, messages posted on the boat, informative panels, identification cards to take home or exposure to educational videos during pre-trip wharf-time. Showing an educational video has also been shown to prompt positive attitude change towards marine mammals (Fortner, 1985).

Judging from other environmental educational programs, however, it seems that effective interpretation could be the most viable tool to help educate and increase tourist awareness. Interpretation has been referred to as 'social marketing' (Alcock, 1991) or 'behavioural technology' (Gudgion and Thomas, 1991) and its goal should be to "encourage the development of an intrinsically motivated stewardship of the wilderness and foster environmentally responsible behaviour" (Negra and Manning, 1997; Zelezny, 1999). It has been demonstrated that interpretation can help not only to protect the environment but also to increase visitor enjoyment (Jelinek, 1990; Alcock, 1991).

As of late, the importance of interpreter training has been widely discussed by organizations such as IFAW (IFAW, 1997a) and the Whale Conservation Society (Hoyt, 2001). Various researchers have considered what the training should include, and the basics of pedagogy and scientific knowledge seem to be the ones that are most readily agreed upon (Forestell, 1990; Tamzin, 1996; Kimmel, 1999). Interpretation should have a critical issue-focused approach and should be more action-oriented (Russell, 2002). The presence of trained, uniformed interpreters on tour boats could have a positive impact on visitors (Lindberg and Hawkins, 1993). Both the source and how the message is delivered are important and some of the factors that influence credibility are appearance, speaking ability, accessibility, personality, organization, and knowledge (Forestell, 1990; Manfredo and Bright 1991).

Traditionally, interpretive programs have been carried out by governmental agencies such as park and reserve departments. More recently, however, private operators have also recognized the importance of interpretive techniques in responding to the needs of nature-oriented tourists and in helping to protect natural attractions. Some ideas for enhancing the educational value of whale-watching trips are listed in Table 2.2.

Table 2.2: Suggested methods for increasing the educational value of whale watching (Forestell, 1990; Tamzin, 1996; Russell, 2002; Townsend, 2003).

TO INCREASE THE EDUCATIONAL VALUE OF WHALE WATCHING:	
1)	The transition between knowledge-attitude-behavioural change should be carefully examined.
2)	The focus on the spectacle should be de-emphasised to avoid disappointment when whale watching is poor and to ease the pressure on operators and the whales.
3)	Information should be provided in different formats (interpretation. posters, books, videos, pamphlets).
4)	Competent individuals (e.g., trained interpreters. nature guides or researchers) should provide the interpretations; and in a manner that establishes the relevance, completeness and credibility of their formal knowledge base.
5)	Messages should be short and not overloaded with information.
6)	Information should be provided according to the capability of recipients (e.g. novice versus experts).
7)	Cognitive dissonance should be incorporated in order to help people re-think their old opinions.
8)	Affective components should be included in order to increase the human bond with nature.
9)	Opportunities should be given to the tourist to provide feedback, comments and ask questions.
10)	People should be given an opportunity to carry out good intentions, ideally immediately.

2.5 Management of whale watching

Due to the recent expansion of whale watching and its potential impacts on cetaceans, concerns over its sustainability have been raised (Constantine, 1999; Berrow, 2003a; Curtin, 2003; Heckel *et al.*, 2003). "In the past the focus for wildlife management was on producing a harvestable surplus of focal species through control over the organisms, their habitat, and harvesting options. Today, instead, non-consumptive wildlife management has different demands" (Duffus and Dearden, 1993).

To accomplish successful regulation and management of wildlife-directed activities, both human and ecological dimensions must be understood, integrated, and balanced in management planning. At a basic level, the objectives of a management strategy for commercial whale watching should be to minimize disturbance to the whales, to provide an enjoyable tourist experience, and to sustain a viable business for the operators (Duffus and Dearden, 1993; IFAW, 1995). Regulation and management plans are often applied for these purposes.

A proper management plan for commercial whale watching should include: 1) environmental protection as a priority; 2) a balance of statutory and voluntary approaches to regulation; 3) local participation; 4) a collaborative approach; and 5) education (Garrod and Wilson, 2003). It is suggested as well that management of whale watching should involve research and continual monitoring. So little is understood about the fragility of the marine environments and the ecology of cetaceans that it is impossible to suggest management plans without monitoring current use and signs of change (Berrow, 2003b; Bejder and Samuels, 2003; Higham and Lusseau, 2004).

It is questionable whether any cetacean-oriented tourism contexts adequately meet all of these management criteria (Higham and Lusseau, 2004). Some of the reasons for management shortcomings reside in the difficulties of implementing strategies in marine environments. These include: open access issues, interest and user conflicts, limited understanding of marine scientific processes and wildlife characteristics, limited resilience of marine habitat and species, limited effectiveness of legislative, regulatory and voluntary structures, lack of monitoring, and lack of knowledge on species' tolerance and thresholds (Fennel, 1999).

Given the uncertainty regarding the biological effects of whale watching on cetaceans, the first step in managing this activity is to minimize its potential impact (Fennel, 1999). In order to do so, measures to regulate whale watching are being put into place in some of the countries where this activity occurs. Carlson (2004) compiled a worldwide list of documents concerning the management of whale watching and found 38 voluntary codes and 20 pieces of legislation. Garrod and Fennel (2004) analysed Carlson's compilation and noted that there was a high variability among the documents in regards to location, stakeholder involvement, rules, and species involved.

The analysis showed that most documents derived from the Americas (29.3% North America, 24.1%, South America) and from Europe (24.1%). The most prominent stakeholder involved in their development was government (46.6%), followed by NGOs (22.4%), and industry (6.9%). The most common approach distance limit was in the range of 50 to 99 meters (41%), followed by 100 meters (approximately 25%) (minimum 10 m – maximum 500 m). Fifteen documents (26%) suggested no more than one boat approach at a time (minimum 1 – maximum 6). The most common maximum allowable time was 30 minutes (31%) (minimum 10 min - maximum 420 min). Over half (52%) of the cases included a restriction on viewing pods with calves. Eighty-one per cent of documents were defined as being completely deontological (i.e. rules imposed and not justified or explained).

It was found that North America developed many more non-voluntary than voluntary measures, whereas Europe developed significantly more voluntary ones (percentages not reported). NGOs tended to opt for the development of voluntary Codes of Conduct, whereas governments favored the development of regulations (percentages not reported).

The high variance in specific rules, differences in scope, lack of specific research behind certain rules, and lack of industry-developed codes were all considered detrimental to the development of standardized effective management of commercial whale watching (Garrod and Fennel, 2004).

2.5.1 Regulations

Governmental institutions (e.g., Department of Conservation, Department of Fisheries, Department of Tourism, etc.) usually dictate regulatory measures (Carlson, 2004). Measures might restrict certain actions, access, length of interaction, time of day and/or numbers of vessels allowed, and impose codes of practice and speed limits (Duffus and Dearden, 1993; Orams, 1996). At times, regulations are also employed in special areas such as Marine Protected Areas or marine Special Areas of Conservation (EU habitats) (Wilson, 2003).

Under regulatory measures, whale-watching vessels usually operate on a permit basis. Governmental authorities grant permits under different conditions, taking into account skipper experience, safety issues, number of passengers, the presence of a naturalist on board, etc. Most commonly, permits are issued annually, usually entailing re-application and re-examination. It is standard practise to license individual vessels, rather than overall operations, in order to control type and number of vessels in the specific area and limit the monopoly of single tour boat operators (Davis *et al.*, 1997). Places where regulations are in effect include Canada (Quebec), USA (Alaska, Massachusetts), Puerto Rico, Brazil, Argentina, South Africa, Spain, Portugal, Australia, and New Zealand.

"One problem with regulations is that they are only as good as the ability of authorities to enforce them" (Malcolm and Duffus, 2003). "They also need progressively harsher punishment for violators in order to be effective" (Orams, 1996). In Port Phillip Bay, Australia, for example, swim-with-dolphin tours occur under government licensing but no enforcement is in place; a study found non-compliance with the rules on at least 61% of trips (Scarpaci *et al.*, 2003). Therefore, the existence of the licensing program alone did not guarantee that regulations were obeyed.

To obtain compliance with regulations, enforcement is needed (warden, park rangers, etc.). Because of the dynamic nature of marine environments, movements of whales, problems with spatial definitions and jurisdictional coverage, and multiple-use conflicts, enforcement is sometimes difficult to achieve (Wong, 1998; Wilson, 2003). As well, enforcement of regulations is often limited by the high costs involved (IFAW, 1997c). Where regulatory agencies do not have the resources to police the conduct of commercial operators, or to pursue avenues of legal enforcement, the management framework may be disregarded with impunity (Higham and Lusseau, 2004).

Generally, it has also proven difficult to convict perpetrators of whale harassment. For example, between 1977 and 1988, there were 39 cases of whale harassment in

California and Hawaii, fourteen of which were dismissed due to the inability to prove that harassment actually occurred (CMC and NMFS, 1989). In Canada, Baird (1999) mentions a 1993 charge of harassment that was still pending six years later. In 2004, however, two whale-watch operators in the Salish Sea (British Columbia) were prosecuted under the Marine Mammal Regulations of the Canadian Fisheries Act. Department of Fisheries and Oceans (DFO) conservation officers reported the operators' invasive actions in the summer of 2002. The courts ruled that the operators were aware of, yet intentionally violated the voluntary local guidelines for boaters by operating their vessels within close distances to killer whale pods and they were each fined $6,500 CA (maximum fine $100,000 CA) for "harassing a marine mammal." As an important precedent, the judges ruled that 'harassment' did not have to be proven as such, only that the vessel operators were engaging in behaviour contrary to guidelines intended to prevent harassment (Koski and Osborne, 2005)

Another limitation of regulations is the difficulty of implementation in more remote whale-watching communities (Hoyt, 2001). In peripheral locations, regulations may be perceived as dictated by a 'central' distant government. Because these communities are typically fiercely independent and resistant to external influence – an influence that may be perceived to compromise collective or individual values, attitudes and local identities - it can be hard to impose regulation from the outside.

2.5.2 Codes of Conduct

Models of best practice, including Codes of Conduct and accreditation schemes, are being increasingly promoted for the management of whale watching (Berrow, 2003a). Codes of Conduct are essentially "voluntary measures, enforced primarily by ethical obligation and peer pressure" (Gjerdalen and Williams, 2000). Locales where Codes of Conduct are currently in place include Canada (Newfoundland, Nova Scotia/New Brunswick, British Columbia), USA, Mediterranean countries (ACCOBAMS accord), United Kingdom, Galapagos Islands, and a few Caribbean countries.

Self-regulation on a voluntary basis, coupled with education of operators and the public, is regarded by many as being the most effective means of ensuring responsible management of whale watching in the long-term (IFAW, 1997c; Gjerdalen and Williams, 2000; Lee Meinhold, 2003; Garrod and Fennel, 2004). However, compliance with self-imposed rules requires that individuals are aware of and understand the guidelines that they are expected to follow, and that they consider the codes to be fair (Sirakaya and McLennan, 1998).

For this reason the success of most voluntary measures depends on the promoter. In the UK, for example, the most commonly utilized Code of Conduct is the one produced by the Scottish Marine Wildlife Operators Association (Parsons and Woods-Ballard, 2003). Tour boat operators consider this code easy both to understand and to implement, while they do not regard government guidelines in such a favorable light (Parsons and Woods-Ballard, 2003). Furthermore, the success of codes usually varies according to the operators' perceived benefits and costs from compliance. The economic benefits of compliance with the guidelines have proven to be strongly related to behavioural compliance (Sirakaya and McLennan, 1998).

Codes of Conduct usually work through a peer-pressure mechanism. In the case of commercial whale watching, an industry based on the exploitation of a common resource (cetaceans), reckless behaviour of a single operator may negatively impact business in an entire area. Therefore operators can exert pressure on each other in order to maintain a viable (i.e. economically profitable) resource. For example, in Johnston Strait, British Columbia, it was observed that between 1987 and 1989 the frequency of code violation did not follow the rise of whale-watching activities. While use rose by 35%, code violations fell by 71%. The reason was thought to be the peer-pressure that local operators were exerting on each other (Duffus and Dearden, 1993).

In many cases voluntary measures remain the most readily applicable means of managing whale watching, and may be applied in different ways. They can be a first and less dramatic step for the industry to adopt, while waiting for formal regulations of whale watching. Moreover, international organizations, such as the IWC or the Whale and Dolphin Conservation Society (WDCS), can put pressure on local industries, in countries where whale watching occurs, to adopt a Code of Conduct to compensate for regulatory voids or incomplete regulations.

Finally, tour boat operators can use adherence to a code as a marketing tool. For example, large tour boat associations can adopt codes to exceed regulatory standards and therefore attract a higher portion of the more environmentally inclined eco-tourist (e.g.

the *Whale Watch Operators Association North West* of British Columbia, Canada and Oregon, US; www.nwwhalewatchers.org).

It has been suggested that, "the optimum strategy to manage whale watching may be a blend between statutory and voluntary measures"; in this way "management would have the flexibility of the voluntary approach and the safety net of the statutory approach" (Garrod and Wilson, 2003). For the most part, codes and regulations are comprised of two components: regulating access and regulating proximity. Government could control the access to the animals through the issuing of permits, while Codes of Conduct could regulate the behaviour of boats within the area, thereby potentially reducing the need for enforcement (Baxter, 1993; Scarpaci *et al.*, 2003). This seems to be a particularly feasible option when whale watching occurs in marine protected areas.

2.5.3 Role of the industry

Increasingly, the active involvement of stakeholders in resource management is being viewed as a critical aspect for the success of sustainable development (Scheyvens, 1999; Berkes, 2004). In the case of whale watching, this includes state bodies, local authorities, local community groups, researchers and the industry itself. "Tour boat operator participation should be encouraged to ensure the quality, effectiveness, and equity of management proposals" (Clark, 1996).

Firstly, tour boat operators may benefit from forming organizations among themselves and/or joining broader organizations. For example, Australia has an established and well-supported National Eco-tourism Strategy and an active national eco-tourism association to which tour boat operators can turn (Orams, 2003). Collaboration among tour boat operators should be encouraged, fostering the idea that they all share a common resource.

Secondly, tour boat operators must be involved in establishing the guidelines. Indeed, it has been shown that stakeholders involved in the formulation of policies and rules are more likely to support and comply with them (Gjerdalen and Williams, 2000; Heckel *et al.*, 2003). Also, local people usually know more about the area and may be better at identifying relevant issues. Local knowledge can be particularly important for situations in which formal scientific research is lacking. Involving local people could also help decentralize the management of natural resources and achieve a more sociably acceptable management system (Garrod and Wilson, 2003; Higham and Lusseau, 2004).

Thirdly, it has been shown that incentives work better than punishment. Tour boat operators that understand the value of the guidelines are the best warranty for compliance. Authors have also suggested that a competitive rating system where green stars are awarded to the most environmentally friendly operation should be adopted to enhance compliance (Sirakaya and McLennan, 1998).

Fourthly, it has often been argued that whale watching can help local economies to grow, especially in remote areas that lack tourist revenue or where traditional industries have collapsed (IFAW, 1997b; Hoyt, 2001; Parsons *et al.*, 2003). In order to be of benefit to the local economy and to avoid external revenue leakage, whale-watching activities must be locally owned and managed. Some examples of locally owned enterprises already exist, such as the New Zealand's Maori-owned Whale Watch operation in Kaikura (Curtin, 2003) or the industry in the Azores mainly owned by ex-whaling captains (Neves-Graca, 2002).

Fifthly, in order for the whale-watching industry to comply with high eco-tourist standards and to use the *eco-label* marketing tool, it has an obligation to provide an educational experience for the customers. This should include careful marketing and advertising, building reliable expectations in the tourists, and providing up to date information and interpretation programs. Tour boat operators should also help set up onshore interpretation centres in areas where whale watching occurs. This could help increase visitor staying-time, and therefore provide extra revenue and education.

Finally, tour operators, in order to prove the often-asserted sustainability of their activity, must work collaboratively with institutions to undertake both scientific and social research. In addition, according to the polluter-pay principle, a levy to support research and conservation should also be considered. Tour boat operators could advertise that money goes directly into research of the local areas. Studies have shown that, in this case, people are more willing to pay access fees (Berrow, 2003a; Garrod and Wilson, 2003). Examples of collaborations between industry and research institutions are available (Watkins, 1986; Constantine, 2001; Scarpaci *et al.*, 2003; Higham and Lusseau, 2004).

2.6 Thesis rationale: adaptive management and the need for a study on the effectiveness of a Code of Conduct

The review of the literature I have presented has shown that whale watching does not necessarily fulfil the requirements of sustainable eco-tourist activities. In particular, it has been demonstrated that whale watching can have an impact on target species, has a limited educational value, and in some cases, has been far from satisfactorily managed.

There is general consensus that some of the limitations of whale-watching management derive from how rarely the performance of management plans are evaluated (Garrod and Wilson, 2003) or subjected to monitoring (Berrow, 2003a; Bejder and Samuels, 2003). This has led to a lack of knowledge about effects on the marine environment and animals targeted, about the extent of tour boat compliance with codes or regulations, and about how management plans affect the economic and socio-cultural environments in which whale watching takes place.

Studies have shown that the most promising examples of management occur when some form of *adaptive management* has been applied (Neves-Graca, 2002; Heckel *et al.*, 2003). Adaptive management is based on the "involvement of stakeholders, transparency in the decision-making process, public education, and reliable knowledge of societal and ecosystem change" (Olsen and Christie, 2000). Commitment on the part of commercial operators and management agencies to an ongoing monitoring research program must happen in order to review systematically any regulatory or voluntary structures (Wilson, 2003; Higham and Lusseau, 2004) and to obtain a more flexible management plan (Blane and Jaakson, 1995). Ideally, scientists unconnected to the operations but knowledgeable of the area should complete the monitoring (Leaper *et al.*, 1997).

In Canada, cetaceans are protected under the Fishery Act (see Chapter 3). Other than in Quebec, however, the government does not presently regulate whale watching. Commercial whale watching has occurred in Newfoundland and Labrador for the last twenty-five years, but a voluntary Code of Conduct for commercial tour boat operators was not introduced until 2001.

The aim of this thesis is to investigate the effectiveness of the voluntary Code of Conduct as a management strategy for commercial whale watching in Newfoundland and Labrador. More specifically, the research questions posed include the following:

1) Is the Code of Conduct considered to be a useful management tool by the operators?
2) Is the Code of Conduct understood and implemented by the operators?
3) Can operators enforce the Code of Conduct through a peer-pressure mechanism?
4) Does compliance with the Code of Conduct influence passenger satisfaction?
5) Does the Code of Conduct enhance the educational outcome of whale watching?
6) Can whale watchers enforce the rules of the Code of Conduct?
7) Do interactions with tour boats influence humpback whale behaviour?
8) Does compliance with the Code of Conduct reduce the impact of tour boats on the whales?

To answer these questions the author collected data between 2000 and 2004 through personal observation, telephone and in-person interviews with tour boat operators, pre- and post-trip passenger questionnaires, whale behavioural sampling from cliffs, from tour boats and from an independent research vessel, and deployment of VHF-TDR (time depth recorder) tags on whales. Approval for these studies was obtained from the Interdisciplinary Committee in Human Research and from the Animal Care Committee of Memorial University of Newfoundland (protocol numbers: 2000/01-046-SC; 2000/01-047-SC; 02-61-JL; 03-11-RT).

The remainder of this thesis will be divided into the following chapters:

- **Chapter 3 – *Whale watching in Newfoundland and Labrador.*** I will here introduce the characteristics of commercial whale watching in NL, provide information on the target species and describe the Code of Conduct.

- **Chapter 4 - *The effects of the Code of Conduct on the tour boat operators*.** I will here report tour boat operators' reactions to the code's introduction and the extent of tour boat operators' compliance.

- **Chapter 5 – *The effects of the Code of Conduct on the passengers*.** I will here analyse the effects of the Code of Conduct on passenger satisfaction and environmental awareness, and also test the effectiveness of formal deliveries to enhance the educational value of whale watching in NL. Finally, I will consider the feasibility of a passenger enforced Code of Conduct.

- **Chapter 6** – ***The effects of the Code of Conduct on the targeted whales***. I will here first introduce the different techniques used for studying humpback whale behaviour during the interaction with the tour boats including the innovative VHF-TDR tagging study. I will test the effects of the tagging procedure on humpback whales, and I will provide an insight into the diving profiles of whales in Witless Bay. Finally, I will analyse the effect of tour boat activities on humpback whales and the utility of the Code of Conduct in limiting possible impact on the whales.

- **Chapter 7** – ***Conclusions and Recommendations***

Chapter 3 - Whale watching in Newfoundland and Labrador

3.1 Introduction

Newfoundland and Labrador has a well-developed whale-watching industry. It accounts for 48% of the total number of communities involved in commercial whale watching in Canada (Hoyt, 2001). Whale-watching activities started in Newfoundland and Labrador in the beginning of the 1980s; by 2000, 63 tour boat operators were reported in this province (Hollet and Sons, 2000). A significant percentage of tour boat activity is concentrated in the island portion in centres such as St. John's, Witless Bay, Trinity, Twillingate and St. Anthony.

At least six Newfoundland communities report that 3 to 4 new businesses per community have opened since whale watching began to expand rapidly in the mid-1990s (Hoyt, 2001). The average tour price for short trips in 2001 was $30 CA. Package or multi-day trips ranged from $150 to $2,000 CA (Hoyt, 2001). In Newfoundland, whale watching has become an important socio-economic activity, providing an estimated 100 full-time jobs and 180 part-time jobs in tour boat companies (Hoyt, 2001). The rapid growth of this activity was facilitated by the cooperation between operators and the provincial tourism department in an attempt to fill the economic gap left by the collapse of the commercial ground-fish industry (Hollet and Sons, 2000).

3.2 Target species

Whale watching in Newfoundland and Labrador is particularly successful because of the accessible presence of cetaceans in many locales along its coasts. The primary target of whale watching in this province is the humpback whale, although minke and fin whales are sometimes advertised as well. On occasion long-finned pilot whales (*Globicephala melas*), Atlantic white-sided dolphins (*Lagenorhynchus acutus*), white-beaked dolphins (*Lagenorhynchus albirostris)*, harbour porpoises and killer whales are also subjects of whale watching. The abundance of some of these species close to shore is attributable to the high presence of schooling fish such as capelin (*Mallotus villosus*) and herring (*Clupea harengus*) that spawn in the summer on the shores of Newfoundland and Labrador and upon which whales feed (Piatt *et al.,* 1989).

It appears that since the end of the 1970s there has been an increase in the abundance of cetaceans close to shore, especially humpback whales (various whale-watching captains, personal communication; most of whom were fish harvesters in the 1970s). In 1985, Whitehead and Carscadden suggested that spatial redistributions of capelin and possibly a decrease in the offshore spawning stock were attracting whales inshore.

3.2.1 Humpback whales

Humpback whales visit Newfoundland and Labrador waters during summer months. These whales are part of the North Atlantic population, estimated at 11,570 individuals

(10,290 – 13,390, 95% CI), growing at an average rate of 0.031 over a 14-year period, 1979-1993 (Stevick *et al.*, 2003). Recently, new genetic analysis suggests that pre-whaling numbers could have been as high as 240,000 individuals (Roman and Palumbi, 2003); this number is two orders of magnitude greater than previous estimates (Whitehead, 1987) and may be upwardly biased (Baker and Clapham, 2004). North Atlantic humpback whales are listed in Appendix I of the Convention on International Trade of Endangered Species of Wild Fauna and Flora (CITES, 2005), as vulnerable in the International Union for the Conservation of Nature and Natural Resources Red List (IUCN, 2004), as endangered under the Endangered Species Act (ESA) (US Fish and Wildlife Service, 2005), and as not at risk by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC, 2006).

North Atlantic humpback whales are migratory and generally spend summer months in higher latitudes for feeding (Gulf of Maine, Newfoundland and Labrador, Greenland, Iceland and Norway) and winter months in lower latitudes for breeding and calving (mostly West Indies) (Martin *et al.*, 1984). In the past, the North Atlantic population was considered panmictic (Mattila *et al.*, 1989; Clapham *et al.*, 1993b; Stevick *et al.*, 1999). More recent findings, however, suggested the existence of two distinct breeding populations, with a number of the eastern North Atlantic humpback whales (that feed off Iceland and Norway) wintering in the Cape Verde Islands (Wenzel *et al.*, 2005).

Inter-annual site fidelity for feeding grounds has been shown (Clapham *et al.*, 1993a). This fidelity to migratory destination seems to be maternally directed (Baker *et al.*, 1990). Evidence of juvenile individuals feeding in mid latitudes during the winter (Swingle *et* *al.*, 1993) suggests that some individuals may not migrate to the breeding grounds until later in life (Clapham *et al.*, 1993a), and perhaps only when sexually mature (Dr. Jon Lien, personal communication).

At birth humpback whales measure between 4 and 5 meters, while as adults they can reach up to 15 m and weigh 30 tonnes (Clapham *et al.*, 1999b). Females are typically 1 to 1.5 m longer and reach maturity earlier than males (5 versus 6-7 years of age) (Clapham, 2002). Due to competition with older individuals, however, males probably do not reproduce until later in life (Clapham, 1992).

In higher latitudes, adult humpback whales (especially females) have been shown to associate together in order to increase feeding efficiency (Weinrich and Kuhlberg, 1991). These groups are usually temporary but long-term associations have been also documented (Weinrich, 1991). Mother and calf pairs are usually the most stable association present in the feeding grounds (Whitehead, 1983).

Humpback whales feed on euphausiids and on small schooling fish such as capelin, herring, sandlance (*Ammodytae*), mackerel (*Scomber scombrus*) and others (Laerm *et al.*, 1997). There are reports of sporadic feeding on euphausiids in the breeding grounds, but humpback whales usually fast during the winter (Baraff *et al.*, 1991; Gendron, 1993). Feeding behaviour may include thrashing, lunge feeding, bubbling, skimming the sea bottom and lobtailing (Hain *et al.*, 1982; 1995; Weinrich *et al.*, 1992b; Clapham *et al.*, 1995).

Behaviour at the surface entails a series of blows (4-8), usually followed by dives lasting from 3 to 15 minutes depending on the whale activity and prey distribution

(Bredin, 1985; Dolphin, 1987b). Humpback whales also display aerial behaviour such as flippering, breaching, and lobtailing. Aerial behaviour may be for communication, power display, or expression of excitement or annoyance (Clapham, 2002). Acrobatic behaviour, slow swimming speed, and the fact that they occasionally approach vessels make humpbacks preferred targets of whale-watching boats.

3.2.2 Fin and minke whales

The North Atlantic population of fin whales has been drastically reduced by whaling and is now estimated at 47,300 animals (27,700 – 82,000, 95% CI, www.iwcoffice.org). Pre-whaling numbers are debated, although it is known that large numbers were taken in Atlantic Canada (11,815 specimens between 1903 and 1945; COSEWIC, 2005). Fin whales are listed in Appendix I of CITES (2005), as endangered in the IUCN Red List (IUCN, 2004), as endangered under ESA (US Fish and Wildlife Service, 2005) and as special concern under COSEWIC (2006).

Fin whales are a migratory species and are widespread throughout the temperate and sub-polar waters of the world's oceans. They usually spend summer months in cold and highly productive areas preying on krill, small schooling fish and small squids (Kawamura, 1980). While feeding, they may occasionally form temporary associations with other individuals (Whitehead and Carlson, 1988). Locations of wintering grounds are largely unknown. The Newfoundland and Labrador population is believed to move offshore into the Gulf Stream or perhaps to head further south. Fin whales reach sexual maturity at around 6 or 7 years of age and can reach 22 m in length and 60 tonnes in weight (Carwardine, 2000). At the surface, they typically blow 2 to 5 times before diving for 5 to 15 minutes (Aguilar, 2002) and they may occasionally breach or lunge at the surface while feeding. They are fast and unpredictable swimmers, reaching up to 15 knots. In Newfoundland and Labrador, whale watching may occur opportunistically with these whales, but they tend to be difficult targets for boats.

Minke whales are the most abundant baleen whales in the North Atlantic, with estimated population numbers of 149,000 (120,000 – 182,000, 95% CI, www.iwcoffice.org). These whales are listed in Appendix I of CITES (2005), as at lower risk in the IUCN Red List (IUCN, 2004), are not listed under ESA (US Fish and Wildlife Service, 2005) and are considered not at risk by COSEWIC (2006).

Minke whales are present in all oceans, but are more common in cooler waters. The Antarctic minke whale is now recognised as a separate species (*Balaenopera bonaerensis*) (Rice, 1998). North Atlantic minke whales summer as far north as the Arctic. The wintering grounds are less well known, but are thought to extend as far south as the Caribbean in the West and the Strait of Gibraltar in the East (Perrin and Brownell Jr., 2002). Some coastal minke whales are known to restrict their activities to exclusive home ranges (Dorsey, 1983) and exhibit fidelity to these areas between years (Borggaard *et al.,* 1999). Staple food in Newfoundland and Labrador is capelin and various species of benthic fish (Steward and Leatherwood, 1985). Minke whales are the smallest baleen whales, reaching 8 meters in length and weighing up to 15 tonnes (Perrin and Brownell Jr., 2002). Sexual maturity is reached at 6 or 7 years of age. When at the surface they may blow 5 to 8 times, with dives lasting up to 20 minutes. They are quick and erratic swimmers, making them difficult to follow. Minkes are thus rarely direct whale-watching targets in Newfoundland and Labrador, despite frequenting the same areas as humpback whales and being regularly spotted during whale-watching trips.

3.3 Witless Bay

The area of highest concentration for this province's commercial whale watching activities occurs in the vicinity of the capital, St. John's. The whale-watching fleet in this area is around 15 boats, most of which operate out of Witless Bay.

Witless Bay (47° 16.367' N; 52° 48.699' W) is a rich and productive coastal area, located 30 km south of St. John's (see map, Appendix A). Due to its productivity, it provides habitat for a diversity of seabirds breeding on several small islands just outside the bay, including the largest concentration of Atlantic puffins (*Fratercula artica*) in North America and the world's second largest Leach's storm petrel colony (*Oceanodroma leucorhoa*). Other species of seabirds that can be found breeding here include the blacklegged kittiwake (*Rissa trydactyla*), the common murre (*Uria aalge*), the razorbill murre (*Alca torda*), and the black guillemot (*Cepphus grylle*). Their presence provides an additional draw for tourists.

During the summer months, Witless Bay is also home to a multitude of whales, mainly humpback, fin and minke. Their abundance is strongly correlated with the presence of capelin coming close to shore to spawn. Whales do not usually congregate in

Witless Bay until capelin school abundance exceeds threshold levels (Piatt and Methven, 1992). Humpback, fin and minke whales in this area are found in the proportion of 10:1:3.5, according to Piatt *et al*. (1989). Other species of cetaceans that have been sighted include white-sided and white-beaked dolphins, harbour porpoises and, on occasion, travelling pods of killer whales.

Due to its importance as an ecosystem, Witless Bay was declared a Wildlife Reserve under the Provincial Wildlife Act in 1964, with the specific purpose of protecting the sea-bird breeding colonies. In 1983, the same area was designated as an Ecological Reserve under the Wilderness and Ecological Reserves Act (O.C. 97-246; and since updated; www.hoa.gov.nl.ca/hoa/regulations/rc961100.htm). Four islands and a one-kilometre marine boundary around them are protected (see map, Appendix A).

In 1994, the Management Plan for Witless Bay was approved, but it has received little attention due to the lack of funding (Doug Ballam, personal communication). Tour boat operators are required to have permits in order to enter the boundaries of the Reserve to observe the sea bird colonies. These permits are granted by the provincial government's Department of Tourism. A high proportion of whale watching, however, occurs outside of the Reserve and no permits are necessary for this activity.

3.4 Characteristics of the tour boat industry in Witless Bay

The whale-watching industry has been growing in the Witless Bay area since the beginning of the 1980s, and now it is estimated that between 30,000 and 40,000 tourists go whale watching in Witless Bay each year (Joseph O'Brien, personal communication). The main departure harbours are located in the three main communities of Bay Bulls, Witless Bay and Bauline East, with a total of 70 people employed by the whale-watching industry, or 3% of the total local population in these three communities.

There were 2 tour-boat operations in 1984, 3 in 1993, 6 in 1996 and 7 in 2000 (Fig. 3.1; y2 axis; statistics presented in this section were collected through personal observation and interviews with company owners performed in November 2004; methods in Appendix B). As of 2005, six tour boat companies are currently active, but a new tour boat company plans to begin its operations in Witless Bay in 2006 (Mary Smyth, personal communication).

The number of vessels grew from 3 in 1984 to 11 in 2001 and remained steady after that (Fig 3.1; y2 axis). Of these, 8 have in-board diesel engines and vary in length between 10 to 20 meters. Three are wooden boats (10 m in length), four are fibreglass Cape Islanders (between 12 and 15 m), and the biggest is a fibreglass catamaran (20m). The load capacity of these vessels varies from 12 (smaller wooden boats) to 150 passengers (catamaran, its capacity was upgraded in 2005). Two companies also use smaller boats (average 7 ± 0.5 m in length). Two are hard-hulled zodiacs, one with two 4-stroke outboard engines and one with jet propulsion. The third is an aluminium boat with two 4-stroke outboard engines. These can carry up to 12 passengers.

In addition to acquiring new vessels, tour boat operators also constantly upgraded their fleet over the years, including replacing old engines with new and faster models, fitting their boats with crow's nests to better spot whales, and expanding boats' load capacity. The total combined load capacity of the fleet has increased from 117 passengers in 1983 to 477 in 2005 (Fig 3.1; y1 axis). Speed of vessels varies from 7 - 8 knots for the slower boats up to 30 knots for the zodiacs. Cruising speed of the catamaran is 20 - 25 knots. Four of the 11 vessels have caged propellers, however this is not a requirement for tour boats. The number of skippers varies from 1 to 5 depending on tour boat company.

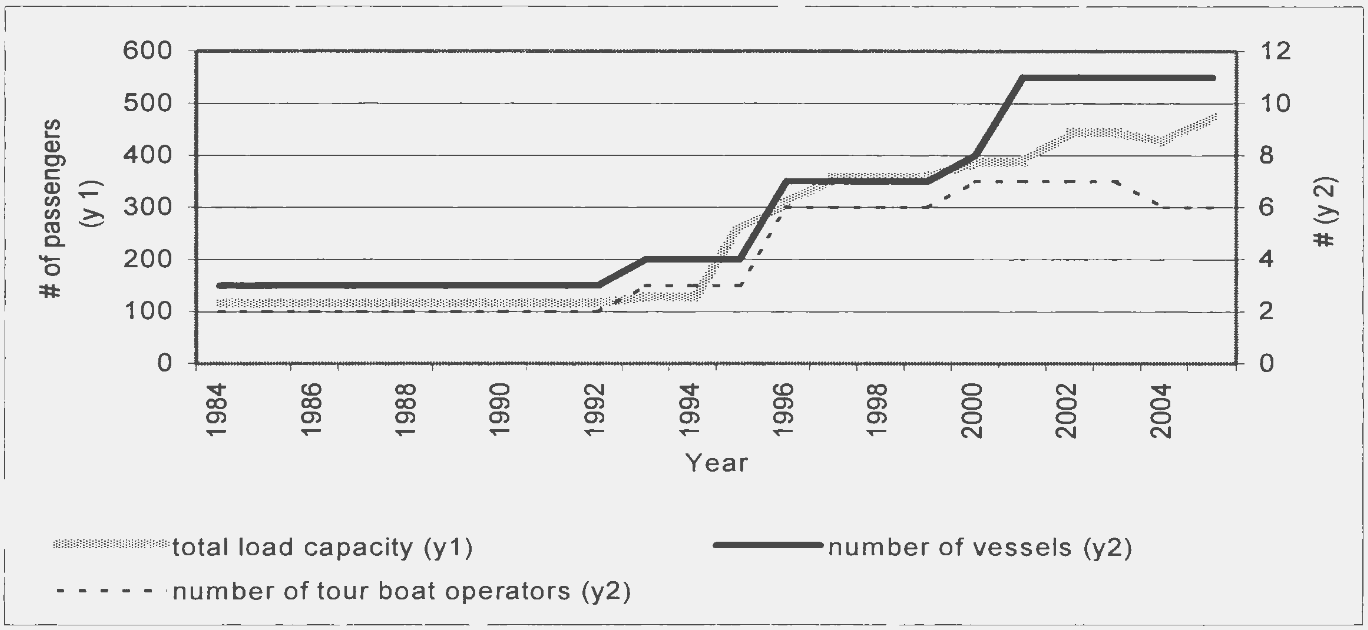

Fig. 3.1: The growth of commercial whale watching in Witless Bay (1984-2005) (From information gathered through personal observation and interviews with company owners, performed in November 2004, n = 6).

Tour boats operate from the middle of May to the end of September. Number of trips per day per company varies from 4 to 8. Length of the trips varies from one hour to two and a half hours, partly depending on weather conditions, as well as whale abundance and distribution.

According to operator estimates provided during a phone survey (November 2004), the total number of commercial whale-watching trips in Witless Bay in a season is around 3,100. The estimated interaction time with whales is 25 ± 19 min (Ave ± SD, n = 6, range 10 – 60 min), which makes for a total of 1,292 h of whale watching in a season (or 1,162 h, assuming that 10% of the days in a season are not good for whale watching due to poor visibility and/or rough seas). Vessels commonly travel to the sea-bird colonies and the estimated time spent bird watching is 27 ± 20 min (Ave ± SD, n = 6, range 10 – 60 min). Distance covered per trip to see whales is between 2 and 15 miles, with the tour boat operators leaving from Bay Bulls making longer trips. Four out of six companies have tour guides on board to provide interpretation of the whales and of the marine environment. In the other two companies the operators provide the interpretation. In addition to the boat tours, two companies also operate a restaurant and a gift shop, with one of these further providing kayak tours, and a shuttle service to and from St. John's.

There was an initial intention to include all 7 operators in the Witless Bay area in the research, but this proved unfeasible for logistical reasons. Instead, the four companies using the five larger vessels (> 10 m) were included. These vessels carry the majority of the passengers in the area and also contribute the most to the local boat traffic. The effects of the smaller vessels belonging to these companies were not evaluated.

For ethical reasons, certain details are intentionally omitted from this paper. Although individual variability was included in the analysis, the implications of significant results are not always discussed in full. For example, the influence of tour boat companies on educational value, of skippers on compliance, and of vessel differences on impact were noted but not explored. There has been an ongoing rivalry among operators in the area and the researcher decided to not include revealing details that would allow fingers to be pointed and this competitive climate to be fuelled.

3.5 Status of management of whale watching in Canada

The agency responsible for the management of cetaceans in Canada is the Department of Fisheries and Oceans (DFO) (Carlson, 2004). Protection to cetaceans is granted under the Fishery Act, which states that: "No person shall disturb or kill a marine mammal except when fishing for marine mammals under the authority of the Marine Mammal Regulations" (Marine Mammal Regulations, Section 7, SOR/93-56, February 24th, 1993). Some species (e.g. blue whales, bottlenose whales, belugas, etc.) are also protected under the Species at Risk Act (2003).

Regulations for whale watching are now in place for only one location in Canada, the Saguenay-St. Lawrence Marine Park, Quebec (St. Lawrence Marine Park Act, P.C. 2002-201, February 20th, 2002). Whale watching is also discouraged in the Robson Bight-Michael Bigg Ecological Reserve, BC in order to protect important habitats for killer whales (Johnstone Strait Whale-Watching Guidelines, Johnstone Strait Killer Whale Joint Management Committee, 1994).

At the time this thesis was being written, proposed amendments to the Marine Mammal Regulations were being evaluated and consultation meetings were being held by DFO (British Columbia). These amendments would include detailed regulations for whale-watching activities based on a 100 m exclusion zone, and a specific licensing program. A draft for the amended Marine Mammal Regulations is available at: www-comm.pac.dfompo.gc.ca/pages/consultations/marinemammals/default_e.htm.

In anticipation of DFO regulations, Codes of Conduct have been adopted by local whale-watching industries in some locations. This has happened in New Brunswick for the Bay of Fundy (www.new-brunswick.net/new-brunswick/whales/ethics.html), in British Columbia (www.nwwhalewatchers.org/guidelines.html), and in Newfoundland and Labrador.

In Newfoundland and Labrador, Dr. Jon Lien of the Whale Research Group at Memorial University proposed the introduction of a voluntary Code of Conduct for tour boat operators in 2001, following concerns about the possible impacts of increasing, unregulated and unmonitored commercial whale-watching activities. "A practical, precautionary code that fits local vessels, local conditions and particular target species would likely be more desirable than a one-size-fits-all set of federal regulations. If the success of such an approach could be demonstrated, it may preclude the need for additional regulations" (Dr. Lien, interview, quoted in St. John's Telegram, 2001). Hospitality Newfoundland and Labrador (HNL), the provincial professional tourism industry association, was designated as the coordinating institution (www.hnl.nf.net).

Dr. Lien presented a draft of the Code of Conduct at consultation meetings held in St. John's with representatives of HNL and with local tour boat operators. The Adventure Tourism Association of Newfoundland and Labrador (ATANL) and the Department of Fisheries and Oceans (DFO) also provided assistance. The code proposed was based on general principles for whale watching put forward by the IWC Scientific Committee (IWC, 1997). The principles were built on recommendations provided by whale scientists based on their personal experiences studying cetaceans and on common sense, not on results obtained through systematic research. Minimum approach distances, for example, were only tentative, and not based on biological data.

During several consultation meetings, feedback was received and revisions were made. A copy of the final Code of Conduct is presented in Appendix C. Tour boat operators who subscribed to the code were allowed to use it as a marketing tool. The Code of Conduct is based on a 100 m rule and operators must refrain from approaching whales closer than this distance. No more than two tour boats can approach the same whale or the same pod of whales at the same time. Approaches must be parallel to animal path, from behind. Chasing and boxing in whales are not allowed. Operators should also limit their impact on the marine environment, including reducing noise and pollution.

When signing onto the code, operators commit to high industry standards and the provision of a safe, first-rate whale-watching experience, including the promotion of environmental education. HNL does not actively monitor tour boat activity nor enforce the rules of the code. Enforcement is left up to passengers, who would report infractions to ATANL (this is specified in the code). Multiple reports of failure to comply with the guidelines could lead HNL to revoke the marketing privileges granted by the code and in extreme cases to revoke operator membership in HNL. To date only one report has been filed by a passenger, in 2002. HNL sent a letter of reprimand to the operator, but no further measures were taken (Mary Smyth, personal communication).

Chapter 4 – The effect of the Code of Conduct on tour boat operators

4.1 Introduction

Following concerns about unregulated whale-watching activities in Newfoundland and Labrador, and in anticipation of the DFO-proposed amendments to the Marine Mammal Regulations, a voluntary Code of Conduct was introduced in this province in Spring 2001. Out of 63 tour boat companies active on the island, 25 (40%) signed onto the code.

Each year, the Newfoundland and Labrador Department of Tourism organizes workshops in the Witless Bay area for tour boat operators and guides prior to the whale-watching season. These workshops involve discussion of and information on Ecological Reserve licence issues, local species and, as of 2001, the voluntary Code of Conduct. Tourism representatives, members of the Whale Research Group, and other researchers from Memorial University and various institutions give presentations on the biology of local species and on matters related to impacts of tourism on the natural environment. Attendance has not been a requirement for operators, however, and participant numbers tend to be very low (around 20% of those who signed onto the code). No modifications to the code have yet been introduced.

During summer 2001, I performed informal interviews with skippers in Witless Bay in order to collect their first impressions of the Code of Conduct. In fall 2001, a telephone survey was also conducted with operators in Witless Bay and in other parts of the province to gather tour boat operators' opinions after the first whale-watching season under the code was completed.

In the following years, I performed two studies in Witless Bay to evaluate how effectively the code was being implemented. In 2002, I set out to determine if the tour boat operators respected the 100 m exclusion zone. This rule specifies that operators are not allowed to actively position the boat closer (or to remain closer) than 100 m from a whale. If a whale approaches a boat, operators can stay within 100 m as long as they disengage their engine and refrain from manoeuvring to get any closer. This rule was designed to leave conditions and length of boat-whale interactions up to the whales. When the whales move further away than 100 m, tour boat operators can then reengage the vessel's engine.

In the second study (2004), I again tested the level of compliance with the 100 m rule and also looked into two other rules of the Code of Conduct. These rules state that operators are not allowed to approach a whale from the front or from the side and that a whale may not be approached when already engaged by two other vessels.

For both studies I performed an analysis of boat navigation parameters (e.g. boat speed, headings, GPS position) and looked at whether other factors such as atmospheric and sea conditions, time of season, whale general behaviour, and number of passengers on board influenced the interactions. For one tour boat operator I was able to collect data for both 2002 and 2004. This gave me the chance to test potential changes in compliance over time.

4.2 Materials and Methods

4.2.1 Interviews and survey (2001)

Interviews with skippers were carried out on board vessels over the course of the 2001 whale-watching season. Interviews were unstructured and were conducted *ad libitum*. They lasted from 20 to 60 min. At least one skipper from each of the main tour boat operations in Witless Bay (n = 7) was interviewed, for a total of 10 interviews.

The November telephone survey consisted of fourteen questions (see Table 4.3). Out of the 25 tour boat operators that signed onto the code in the province, only 17 participated in the survey. Operators in Witless Bay (n = 7) and in other parts of the Province (including the Southern Shore, Trinity and Twillingate, Northern Peninsula and Labrador) were included in this study. Reasons for failure to participate were: being unable to contact the operators during the allotted time period (multiple attempts were made before they were considered unavailable), personal choice not to take part, a death in the family, and one company that had sold their vessel and was no longer in operation.

4.2.2 Compliance of tour boat operators to rules #1 and #2 of the code (2002).

In order to study compliance with the code, I boarded whale-watching vessels during scheduled boat trips. In all cases, skippers were aware of my presence on board and knew the scope of the study. Observations began when operators arrived in the proximity of whales and started a *whale watch* (i.e., when cruising speed was reduced and operations of the vessel were specifically directed towards approaching and/or maintaining sight of the animal). Commonly, operators announced the presence of whales and the start of a whale watch to the passengers. The whale watch was also signalled by the fact that skippers from two of the companies took position on auxiliary boat controls on the boats' sky-decks in order to have a better view of the animals during interactions (as opposed to manoeuvring from the wheelhouse during cruising). In Witless Bay, operators commonly perform a single whale watch per trip; secondary short interactions may occur, but these are not sought out (i.e., they are incidental) and are not included in the analysis.

When tour boats started the whale watch, boat navigation parameters were recorded, including speed (knots), GPS position, engine RPM, and boat headings. The on-board instrumentation was used. A laser range finder (Bushnell, Yardage pro 1000) was used to measure boat-whale distance. Parameters were recorded when obvious changes occurred (on average every 2.9 ± 2.5 min, $n = 357$). For each interaction, data were analysed after being reconstructed in 30-second fixed intervals. Weather and sea-state (Beaufort scale) were recorded. The number of passengers on board was also noted. Observations ceased when skippers concluded the whale watch, again often announced to the passengers. At this point, cruising speed was resumed and boat manoeuvring was now unrelated to whale movements. Skippers who had taken positions on the sky-decks most commonly returned to the wheelhouse. A total of 39 boat-whale interactions were analysed.

Five vessels from four different tour boat companies were included in this study (two sister vessels belonged to the same company). Skippers' names were not recorded and therefore this factor cannot be included in the analysis, although it is known that three of these companies employed multiple skippers, while one company had a solitary skipper.

In order to evaluate tour boat conduct, I plotted course changes, speed of the vessel (and/or RPM) and boat-whale distance against time. Parameters used are presented in Table. 4.1. For the purpose of analysis, I also divided the whale-watching season into early (July 1st – 15th), mid (July 16th – 31st) and late (August 1st – 15th). These categories were based on personal observations, on tour boat operators' suggestions, and on reported seasonal abundance of whales and fish in the area (Piatt *et al.*, 1989).

Table 4.1: Parameters used to analyse boat manoeuvring and code compliance.

PARAMETERS USED TO ANALYSE COMPLIANCE TO THE CODE OF CONDUCT	
PARAMETERS	**RATIONALE and/or DEFINITIONS**
AVERAGE SPEED OF THE VESSEL (knots)	
AVERAGE BOAT-WHALE DISTANCE (m)	
AVERAGE LENGTH OF BOAT-WHALE INTERACTION (min)	
NUMBER OF INCREASES IN BOAT SPEED > 1 KNOT	A higher number of speed changes occur when vessels actively pursue whales.
NUMBER OF COURSE CHANGES	A higher number of changes in directions occur when vessels actively pursue whales.
NUMBER OF CATCH-UP MANOEUVRES	**Catch-up manoeuvre** = an increase in boat speed (or a failure to diminish speed), sometimes coupled with a change in boat course, resulting in a decrease in boat-whale distance. *(A vessel actively pursuing a whale has a high number of catch-up manoeuvres).*
INFRACTION #1	Performing a catch-up manoeuvre to enter the 100 m exclusion zone (i.e. the operator gets closer than 100 m to a whale on purpose). *(During data analysis, operators were allowed a 10 m buffer zone before being considered in violation).*
INFRACTION #2	Performing a catch-up manoeuvre when a vessel is already within the 100 m exclusion zone (i.e. operator fails to reduce speed and/or changes boat course so as to remain closer than 100 m from a whale).
INFRACTION #3 (2004 study only)	Approaching a whale when already engaged by two other vessels.
INFRACTION #4 (2004 study only)	Approaching a whale from the front or from the side.

Graphs depicting examples of tour boat manoeuvring and code infractions during boat-whale interactions in the 2002 study are reported in Fig 4.1, 4.2 and 4.3. These are presented here to show the methodology used to identify infraction #1 and #2.

An example of a tour boat operator that respected the rules of the Code of Conduct is reported in Fig. 4.1. At 10:34, a humpback whale surfaced at around 30 m from the whale-watching boat. The operator immediately reduced vessel speed from 2.2 to 1.5 knots and made a 30-degree course adjustment. As a consequence, at 10:35 the whale was at 160 m from the observing boat. By 10:38 the boat had changed direction (25 degrees) and slowed down (1.0 knots), which brought the whale to 138 m from the boat (10:40).

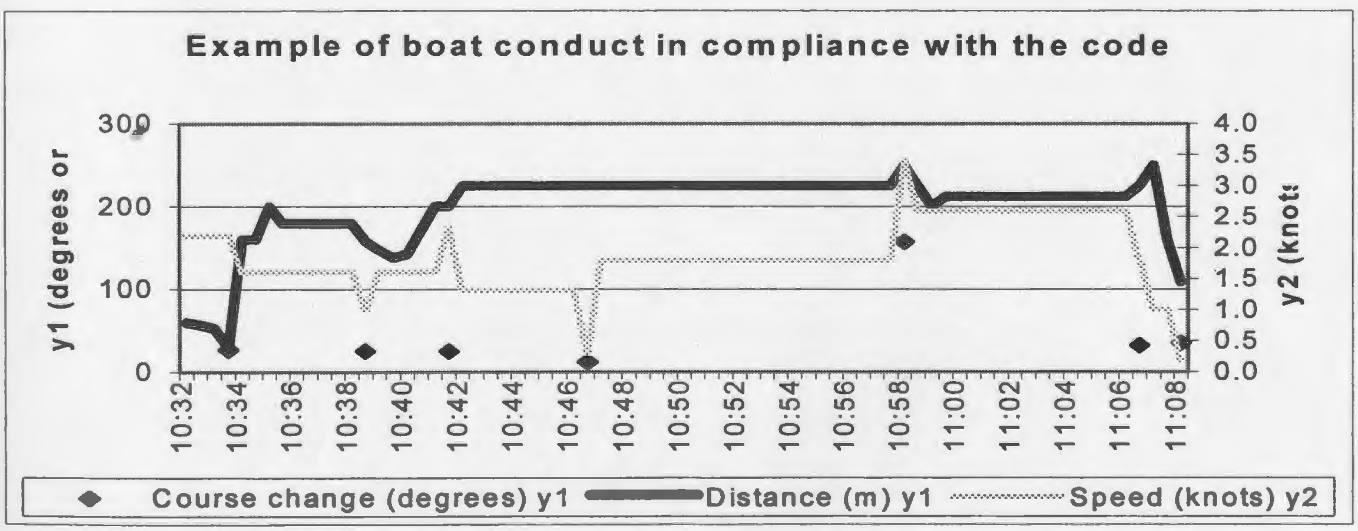

Fig. 4.1: Distance from the targeted whale (y1), boat speed (y2), and course changes (y1) of a tour boat during an interaction with a humpback whale in Witless Bay, when the rules of the Code of Conduct were respected (2002, Whale ID #21).

After a brief increase in speed (2.2 knots), the whale and boat were relatively stationary until 10:47, when the whale started moving at 1.8 knots and the whale-watching boat followed at a steady distance of 225 m. At 10:59 the whale-watching boat increased its speed to 3.4 knots and changed its course by 157 degrees, resulting in a slightly decreased distance from the whale (212 m). This situation was maintained until 11:06. After this, the whale slowed down, the boat changed its course by 32 degrees, and the boat speed was reduced to 0.2 knots. The whale was now at 109 m from the boat, which was the last fix for the interaction (11:09).

Overall, the tour boat operator respected the rules of the code of conduct and did not operate in order to get closer than 100 m. The whale first surfaced within 30 m of the vessel. A reaction from the whale was evident as the animal moved away from the vessel. However the operator reacted accordingly and let the whale distance itself from the vessel before following it. The total number of course changes was 7. Two increases in speed (> 1 knot) were performed as a consequence of the whale resuming travelling and also of the tour boat operator trying to get closer. However, the operator always maintained the 100 m prescribed distance from the whale.

An example in which the Code of Conduct was not respected is reported in Fig 4.2. In this situation, three infractions occurred, at 10:52, 11:06, and at 11:13. In all three cases the tour boat operator performed catch-up manoeuvres to enter the 100 m exclusion zone (infraction type #1). Other indications that the boat was actively pursuing the whale are that the operator increased boat speed (> 1 knot) 5 times and changed boat course 17 times.

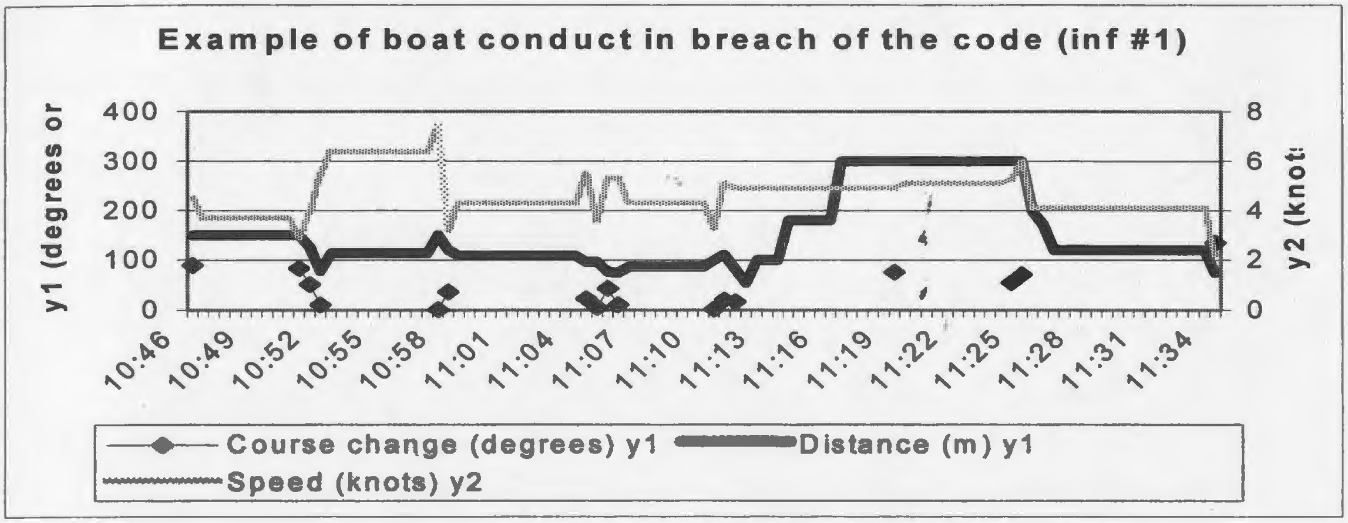

Fig. 4.2: Distance from the targeted whale (y1), boat speed (y2), and course changes (y1) of a tour boat during an interaction with a humpback whale in Witless Bay, when infraction #1 to the Code of Conduct occurred (2002, Whale ID #4).

Another case of failure to comply with the code is reported in Fig 4.3. In this case the tour boat operator performed two catch-up manoeuvres: one to enter the 100 m exclusion zone (at 10:31) (infraction #1) and one when already within 100 m (10:26) (infraction #2). In addition to this, the operator was in breach of the code between 10:22 and 10:31. During this time the operator constantly followed the whale at less than 100 m without reducing vessel speed to allow the whale to move further away than 100 m.

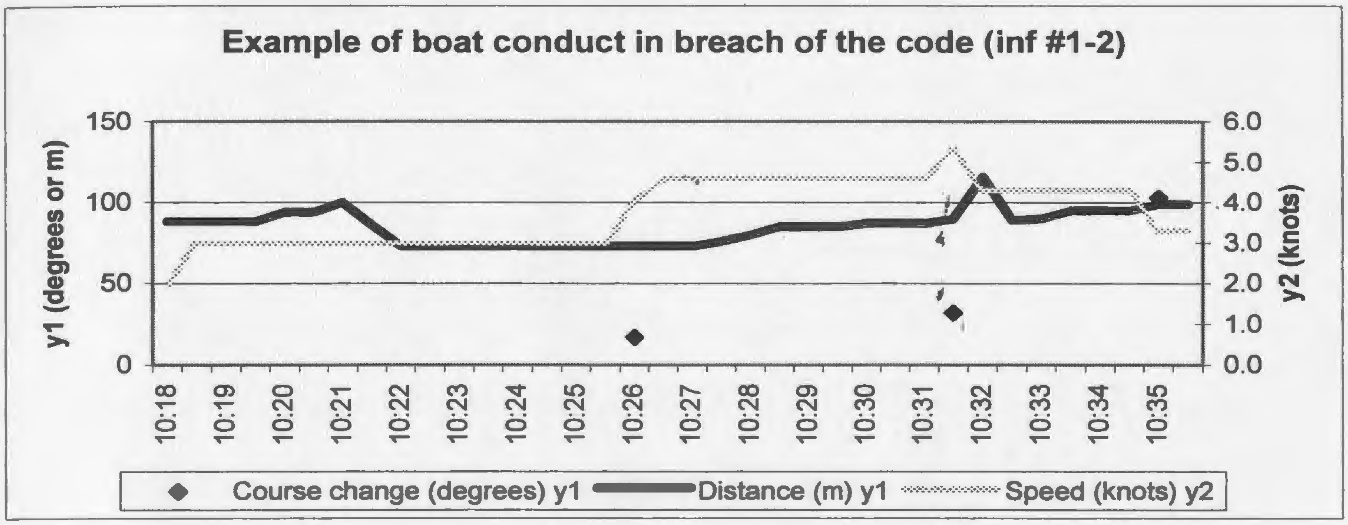

Fig. 4.3: Distance from the targeted whale (y1), boat speed (y2), and course changes (y1) of a tour boat during an interaction with a humpback whale in Witless Bay, when infractions #1 and #2 to the Code of Conduct occurred (2002, whale ID #31).

4.2.3 Compliance of skippers to the rules of the code (2004)

During the summer of 2004, a second study on tour boat compliance to the Code of Conduct was performed. This study was carried out opportunistically while I was testing the educational value of a video about the Code of Conduct in Newfoundland and Labrador. Due to logistical reasons, I was only able to include one tour-company in the study. This company used two identical vessels[1] and employed five skippers, allowing me to conduct statistical analyses to detect differences in skippers' boat manoeuvring.

[1] Data were checked for differences among boats, and none were found (Mann-Whitney: interaction time, $p = 0.13$; distance, $p = 0.41$; speed, $p = 0.72$; increases > 1 knot, $p = 0.57$, course changes, $p = 0.70$, total # of infractions, $p = 0.09$, infractions/min, $p = 0.18$).

As with the previous study, skippers were aware of my presence on board and knew the scope of the study. There were 31 interactions observed in total. Observations were carried out following the 2002 methodology, but this time I positioned myself on the crow's nest to have a better view of the interactions. Atmospheric and sea conditions were recorded. The number of passengers was noted. Boat parameters and boat-whale distance were also measured as with the previous study, with the additional use of a portable GPS (Lawrence, I-Finder) for this season. Whale bearing and direction (towards the boat, stationary, heading away) were also noted. Fish presence and distribution were recorded with the aid of the on board echo-sounder. All parameters were noted any time an obvious change in boat parameters occurred (2.0 ± 1.5 min, n = 317), and data were analysed according to the 2002 methodology. At the beginning of each set of observations, the composition of whale pods and the total number of whales present in the area were also recorded.

Humpback whale behaviour was divided into 4 general classes: feeding, searching, travelling, and resting behaviour. Criteria used for classification are presented in Table 4.2. Classification reflects my own judgment and that of my field assistants at the time of observation, and is not corroborated by statistical analysis. For this reason, if changes to behavioural parameters occurred, these may have passed unnoticed. In these circumstances, our classification only describes the most common behavioural status of humpback whales during the time of the interaction. This method was thought to provide sufficient accuracy for the scope of this study.

Table 4.2: Definitions of humpback whale behavioural statuses used during the 2004 study (Whitehead *et al.*, 1979; Bredin, 1985; Dolphin, 1987b; and personal observation).

BEHAVIOURAL STATUS	DESCRIPTION
FEEDING	Food patches are very concentrated and whales usually stay in the same area; number of blows per surfacing 4-5; blow intervals usually < 25 sec; fluke ups regular; instances of lunge feeding; dives usually last 2-5 minutes (these also depend on the prey item), usually resurface < 100 m, path irregular, speed reduced (usually < 1 m/sec).
SEARCHING	Food patches are present in the area but more sparse; humpback whales travel from patch to patch; 5-6 blows per surfacing; blow intervals 25-35 sec; fluke ups regular; dives last 5-7 minutes; more likely to resurface > 100 m; path usually irregular, speed more sustained (usually between 1 and 2 m/sec).
TRAVELLING	Whales swim rapidly; 5-8 blows per surfacing; blow intervals > 30 sec; fluke ups irregular; dives last 3-5 minutes (usually resurface at > 100 m); path fairly linear; fast speed (> 2 m/sec).
RESTING	Whales are motionless; flukes are not shown; whales surface and submerge parallel to the surface.

Parameters utilised for analysis were the same as the study in 2002 (see Table 4.1), with the addition of the analysis of two other breaches of the Code of Conduct: approaching a whale when already engaged by two other vessels (rule #3) and approaching a whale directly from the front or from the side (rule #4) (thereby checking the four main rules of the code).

4.2.4 Statistics

For statistical analysis of frequency data, Chi square test (χ^2) was used to analyse differences within or between samples (Pearson, 1900). Value of χ^2, p value, sampling number and degrees of freedom were reported.

For interval data, a preliminary population analysis was performed to investigate data distribution. Two tests of normality, Shapiro-Wilk's (Shapiro and Wilk, 1965) and Levane's Test (Levene, 1960), were used. In some cases population distributions proved to be non-normally distributed. Considering this, when analysing differences in two sampling distributions, I always used the non-parametric Mann-Whitney U-test (Mann and Whitney, 1947). Consistency of analysis was favoured in spite of incurring a higher probability of statistical error II. For clarity, means and standard deviations were always used as descriptive statistics. Percentages are usually reported with two significant figures, although sometimes three figures are presented when it was necessary to add up to 100%.

When performing analysis of variance across sampling distributions that included more than two groups, Univariate and Multivariate General Linear Models (GLM) were utilised (McCullagh and Nelder, 1989). These GLM procedures provided regression analysis and analysis of variance for the dependent variable by one or more factors and/or variables. GLM procedures were also chosen because they are robust to departures from normality and heteroscedasticity (McCullagh and Nelder, 1989). Spearman's coefficient rho was calculated to investigate correlation between variables. The statistical package used for data analysis was SPSS 12.0.1 (SPSS Inc., 1989-2004). The level of confidence assumed was 95%.

4.3 Results

4.3.1 Reactions of the skippers to the introduction of the Code of Conduct (2001)

In general terms, the Code of Conduct was well accepted by the skippers. However, they felt that some rules were difficult to apply when sea conditions were not favourable. In these circumstances, maintaining the vessel at a certain angle to the direction of the waves, turning safely or keeping the vessel in motion to avoid too much rocking on board were considered of higher concern. They also stated that safety on board was always their first responsibility and that the Code of Conduct could not be respected in certain situations. Some complained that being observed from a distance might make it appear as if they are harassing the whales. "If you are not on board", they added, "it might appear that we are conducting the boat in a way that could be disturbing the whales, but from far away, it is impossible to judge our decisions."

Regarding specific rules, some skippers noted that the infraction in which an operator purposely chases a whale is, in a certain sense, a repetition of the infraction in which an operator purposely tries to get closer than 100 m to a whale. They argued that if you want to be closer than 100 m you obviously have to 'chase' a whale (unless the whale is approaching the boat). Furthermore they did not find the word 'chase' appropriate. In fact they thought that in certain circumstances it is necessary to chase whales, otherwise they are not able to show them to their passengers. In their opinion this situation is more likely to occur at the beginning and end of the whale-watching season when whales are scarcer and are in search of food that tends to be spread out and in patches, necessitating quicker travel. During peak season when food is more available, whales are higher in number and more stationary, and whale-watching vessels do not need to chase whales, but can idle instead once whales are in the vicinity. Hence, the main suggestion of the skippers was to adapt the Code of Conduct to different parts of the season, with a different version for the early and late season as compared to mid-season.

Another concern of the skippers was the other types of vessels not regulated by the Code of Conduct (including Fishery Patrol) that were seen occasionally in Witless Bay. "Sometimes", they complained, "these boats herd around a pod of whales or they speed when whales are at close distance." "These boats represent only a small percentage of the daily boat traffic", they added "but they do not pose good examples to the eyes of the tourists."

Finally, some skippers suggested that the Whale Research Group should be policing the Code of Conduct: "this group should make all companies subscribe, educate other skippers on how to manoeuvre their boats around whales, and also confront tour boat operators that do not respect the rules."

4.3.2 Opinions of tour boat operators regarding the Code of Conduct after the first whale-watching season (2001)

The results of the tour boat operator survey performed at the end of the 2001 whale-watching season are reported in Table 4.3.

Table 4.3: Results of tour boat operator questionnaire on the Code of Conduct after the first whale-watching season following its introduction.

RESULTS OF TOUR BOAT OPERATOR QUESTIONNAIRE 2001 (n = 17)	
1. Did you regularly inform your passengers that you were following a Code of Conduct?	14 – on a regular basis; 3 – not on a regular basis
2. How did you inform them?	13 – explained before trip and posted for them to read; 4 – explained before trips
3. If you didn't tell them, how would your passengers know that you were following the Code of conduct?	13 – posted up for them to read themselves; 4 – no other way for them to know about the Code
4. Did you have any complaints because you were following the Code of Conduct?	16 – no complaints; 1 – minor complaints
5. Did you have trouble following the Code of Conduct?	17 – no
6. What changes do you think should be made to the Code of Conduct?	14 – no changes; 1 – wording; 1 – include all wildlife; 1 – other
7. Was the development of the Code of Conduct valuable to your business?	8 – yes; 7 – did not hurt it; 1 – no; 1 – do not know
8. Do you prefer a code developed by ATANL or regulations developed by the DFO?	8 – ATANL; 4 – both; 2 – DFO; 2 – no preferences; 1 – do not know
9. Did other tour boat operators in your area sign on to the Code of Conduct?	8 – do not know; 5 – yes; 2 – no; 2 – not applicable
10. Did you observe other operators not following the Code of Conduct?	10 – no; 4 – yes; 3 – not applicable
11. What did you do about operators that did not follow the Code of Conduct?	3 – nothing; 1 – spoke to them directly; 13 – not applicable
12. Should infractions to the code be reported to ATANL or to the DFO?	5 – to both; 4 – should not be reported; 4 – to DFO; 3 – do not know; 1 – ATANL
13. Do you have any other advice regarding the Code of Conduct for next season?	13 – no; 1 – encompass all boat activities; 1 – complaints must be signed; 1 – include kayaks; 1 – education not enforcement
14. Would you like training workshops on the Code of Conduct for tour boat operators?	11 – it is not necessary, code is easy enough to follow; 6 – yes, it is a good idea

The 2001 questionnaire showed that, overall, the introduction of the Code of Conduct went smoothly. None of the tour boat operators claimed to have any trouble following its rules and a majority thought that a training workshop for skippers was unnecessary. Only one reported some minor complaints from passengers due to the implementation of the Code of Conduct. Almost half of the operators were of the opinion that the code was good for their business, possibly because it made the industry look more credible and genuinely concerned for the welfare of the animals. Only one operator thought that the code was detrimental for business.

The majority of the operators reported that the captain or interpreters routinely informed passengers that the vessel was following a code, and the code's content was introduced. Most of the companies also had a copy of the Code of Conduct posted on board the vessel or in the ticket kiosk.

Almost half of the operators agreed that it was the right choice to have a voluntary Code of Conduct developed by HNL, ATANL and the Whale Research Group. Only two operators stated that DFO should have introduced regulations. Almost half of the operators were unaware whether or not other vessels in their area signed up for the code. Four tour boat operators reported observing a vessel not following code guidelines but no complaints to ATANL were filed. In three cases nothing was done and in one case the owner of the vessel was confronted directly. There was also no common agreement on where to report infractions.

A few suggestions were also put forward. First it was recommended that anyone who filed a compliant towards another vessel should have to sign it, in order to prevent bogus complaints. One operator believed that educating operators, rather than enforcement, was the best way to prevent breaking of the guidelines. One operator expressed concern that not all wildlife was included in the code and animals that live adjacent to the water, such as bald eagles, should also be considered. Another one suggested extending the Code of Conduct to sea kayaks.

4.3.3 Compliance of tour boat operators to rules #1 and #2 of the code (2002)

During the 2002 study, the compliance of five vessels from four companies was measured on a total of 39 whale-watching trips. The average duration of the boat-whale interaction was 25.4 ± 10.9 min (range 7 - 54 min). The average boat-whale distance was 143.5 ± 58.4 m (range 45.6 - 283.1 m). The average boat speed was 2.9 ± 1.1 knots (range 0.3 – 4.8 knots). The average number of increases in speed > 1 knot per interaction was 1.9 ± 1.9. The average number of course changes per interaction was 6.1 ± 4.1. This resulted in 83 catch-up manoeuvres (average per trip 2.1 ± 1.4) of which 44 (53%) were infractions to the code. This percentage did not change among different tour boat vessels [χ^2 (4, n = 83) = 4.51, p = 0.34].

In 91% (n = 35) of the trips, boats were within 100 m of the whales at least once during the interaction. In 83% (n = 296) of the cases when the boat–whale distance was less than 100 m during a '*whale watch*', it was because the operators had breached the 100 m exclusion zone. In 17% (n = 61) of the cases the whales had approached the vessel.

Overall the code was breached in 69% of the trips (n = 27). The average number of infractions per trip was 1.3 ± 1.4. The maximum number of infractions in one trip was 7. Infraction # 1 was committed on 49% of the trips, while infraction # 2 was committed on 33% of the trips.

Overall, 57% of the infractions were of type 1, and 43% of type #2 [χ^2 (1, n = 44) = 0.81, p = 0.36]. These percentages did not change with different tour boat vessels [χ^2 (4, n = 44) = 7.76, p = 0.10], during different times of the season [χ^2 (2, n = 44) = 0.28, p =

0.87], or with different weather [χ^2 (3, n = 44) = 2.10, p = 0.55] or sea conditions [χ^2 (3, n = 44) = 3.72, p = 0.29].

During the 2002 study, the number of code infractions per minute across all trips averaged 0.05 ± 0.05 (range 0 – 0.14). This number did not change according to the vessel that performed the interaction with the whales, the number of passengers on board, time of season, sea state or weather conditions (Univariate GLM, $p > 0.18$). The results are presented in Tables 4.4 and 4.5.

Table 4.4: Univariate GLM for the number of code infractions per minute (study 2002), between-subjects factors.

INDEPENDENT VARIABLES	BETWEEN SUBJECTS FACTORS	N
Vessel	1	8
	2	8
	3	3
	4	12
	5	4
Number of passengers (% of capacity)	1-25%	14
	26-50%	15
	51-75%	5
	76-100%	1
Time of season	Early (July 1st- 15th)	7
	Mid (July 16th- 31st)	18
	Late (Aug 1st –15th)	10
Sea state (Beaufort Scale)	0	13
	1	16
	2	4
	3	2
Weather conditions	Foggy	2
	Overcast	4
	Cloudy	3
	Sunny	26

Table 4.5: Univariate GLM for the number of code infractions per minute (study 2002), tests of between-subjects effects.

Dependent variable: NUMBER OF INFRACTIONS PER MINUTE (n = 35)

Source	Type III Sum of Squares	df	Mean Square	F	p value
Corrected Model	0.035	15	0.002	1.34	0.27
Intercept	0.005	1	0.005	2.87	0.10
Vessel	0.009	4	0.002	1.35	0.28
Number of passengers	0.009	3	0.003	1.78	0.18
Time of season	0.004	2	0.002	1.10	0.35
Sea state	0.005	3	0.002	0.96	0.42
Weather conditions	0.004	3	0.001	0.83	0.49
Error	0.033	19	0.002		
Total	0.157	35			
Corrected Total	0.067	34			

Although the number of infractions per minute did not vary, the results in Table 4.6 showed significant differences across vessels in the length of the interactions with the whales (range from 13.7 ± 5.4 to 47.3 ± 6.1 min) and in the number of course changes/min (range from 0.15 ± 0.03 to 0.34 ± 0.07) (Multivariate GLM, $R^2 = 0.47$, $p < 0.01$; and $R^2 = 0.29$, $p = 0.04$). For both variables one vessel/company had longer interactions and more course changes/min (Tukey's post hoc test, $p < 0.05$). Both variables were positively correlated with the total number of infractions per trip (Spearman's rho, 0.48, $p < 0.01$ and 0.37, $p = 0.03$). Other parameters did not change.

Table 4.6: Multivariate GLM for operator boat manoeuvring (study 2002), tests of between-subjects effects (n = 33).

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	p value
Vessel	Average distance	19314.16	4	4828.54	1.63	0.19
	Average interaction time	***2009.93***	***4***	***502.48***	***6.53***	***<0.01***
	Average speed	1.46	4	0.36	0.31	0.87
	Speed increases> 1 knot/min	0.02	4	0.006	2.23	0.09
	Course changes/min	***0.12***	***4***	***2.97***	***2.95***	***0.04***

4.3.4 Compliance of skippers to the rules of the code (2004)

During the 2004 study, the compliance of five skippers from one company was measured on a total of 31 whale-watching trips. The average duration of the boat-whale interaction was 20.9 ± 8.5 min (range 2.7 - 43.7 min). The average boat-whale distance was 116.5 ± 35.8 m (range 60.0 – 188.7 m). The average speed of the vessels was 1.7 ± 0.9 knots (range 0 – 3.5 knots). The average number of increases in speed > 1 knot per trip was 1.4 ± 1.1. The average number of course changes per trip was 9.5 ± 4.6. This resulted in 131 catch-up manoeuvres (average per trip 4.2 ± 3.3), of which 98 (75%) were breaches to the code. This percentage did not change across skippers [χ^2 (4, n = 131) = 6.57, p = 0.16].

In 94% of the trips, boats were within 100 m of the whales at least once during the trip. In 72% (n = 228) of cases in which the boat–whale distance was less than 100 m during a whale watch, operators had breached the 100 m exclusion zone. In 28% (n = 89) of cases the whales had approached the boat.

Overall the code was breached on 77% of the trips. The average number of code infractions per trip was 3.4 ± 3.4. The maximum number of infractions in one trip was 12.

Infraction #1 occurred in 77% of the trips, infraction #2 in 48%, infraction #3 in 3.0% and infraction #4 in 16% of the trips.

Overall, 56.5% of the infractions were of type two, 34.2% of type one, 7.4% of type four, and 1.9% of type three. These percentages were statistically different [χ^2 (1, n = 108) = 83.03, p < 0.01]. Frequencies did not change across skippers [χ^2 (12, n = 108) =

13.72, p = 0.31] or with different weather [χ^2 (9, n = 108) = 6.13, p = 0.72] or sea conditions [χ^2 (6, n = 108) = 3.58, p = 0.73]. However frequencies did change with time of season [χ^2 (6, n = 108) = 15.36, p = 0.01]. In particular, during the early part of the whale-watching season, the most common infraction was infraction #1, while in mid season infraction #2 was the most likely to occur. Overall infraction #1 and # 2 were the most likely infractions to happen (Table 4.7).

Table 4.7: Frequencies of code infractions during different parts of the 2004 whale-watching season.

	Infraction #1	Infraction #2	Infraction #3	Infraction #4	tot	df	χ^2	p value
Early	7	2	1	1	11	3	9.00	*0.03*
Mid	17	45	0	6	68	2	35.67	*<0.01*
Late	13	14	1	1	29	3	21.62	*<0.01*
Tot	37	61	2	8	108	3	83.03	*<0.01*

During the course of the interactions, whales moved away from the vessel 69% of the time, were stationary 16% and moved towards the boat 15% of the time (χ^2 = 209.46, p < 0.01). Boat-whale interactions lasted longer when whales were moving away (23.2 ± 8.9 min) than when whales were going towards the boat or were steady (16.9 ± 6.3 min) (Mann-Whitney, p = 0.04). Interactions also lasted longer when whales were searching for food (26.7 ± 6.3 min) than when they were feeding (18.3 ± 6.0 min) (Mann-Whitney, p = 0.01).

The results presented in Tables 4.8 and 4.9 indicate that the number of infractions per minute changed significantly as a function of to the skipper who performed the interactions (Univariate GLM, $p < 0.05$). Other independent variables such as the time of season, whale behaviour, sea state and weather conditions did not have a significant effect.

Table 4.8: Univariate GLM for the number of code infractions per minute (study 2004), between-subjects factors.

INDEPENDENT VARIABLES	BETWEEN SUBJECTS FACTORS	N
Time of season	Early (July 1st- 15th)	5
	Mid (July 16th- 31st)	20
	Late (Aug 1st –15th)	2
Skipper	1	3
	2	8
	3	3
	4	7
	5	6
Weather conditions	Foggy	2
	Overcast	2
	Cloudy	8
	Sunny	15
Sea state (Beaufort scale)	0	4
	1	17
	2	6
Whale behaviour	Feeding	15
	Resting	3
	Searching	9

Table 4.9: Univariate GLM for the number of code infractions per minute (study 2004), tests of between-subjects effects.

Dependent Variable: NUMBER OF INFRACTIONS PER MINUTE (n = 27)

Source	Type III Sum of Squares	df	Mean Square	F	p value
Corrected Model	0.45	13	0.03	1.76	0.16
Intercept	0.01	1	0.02	0.86	0.37
Skipper	***0.26***	***4***	***0.06***	***3.27***	***<0.05***
Time of the season	0.06	2	0.03	1.44	0.27
Weather conditions	0.05	3	0.02	0.87	0.48
Sea state	0.04	2	0.02	1.14	0.34
Whale behaviour	0.13	2	0.07	3.38	0.07
Error	0.26	13	0.02		
Total	1.36	27			
Corrected Total	0.71	26			

The average number of code infractions per minute for each skipper ranged from a minimum of 0.10 ± 0.09 (n = 6) to a maximum of 0.29 ± 0.22 (n = 7). Skippers did not show any other significant difference in boat manoeuvring (GLM multivariate, n = 27, lowest p value obtained = 0.14; dependent variables considered for this analysis were: average distance to the whales, average speed, average interaction time, speed increases > 1 knot/min).

4.3.5 Comparison of tour boat compliance between 2002 and 2004

For one tour boat operator, it was possible to perform a comparison of boat manoeuvring between 2002 and 2004 (please note this analysis includes all 2004 data plus the 2002 that belongs to this operator). Seventeen trips were analysed in 2002 and 31 in 2004. When the 2004 study was carried out, the operator was not aware of the results of the 2002 study.

The total number of catch-up manoeuvres in 2002 was 33 (average per trip 2.0 ± 1.0) of which 42% were infractions to the code. In 2004, the number of catch-up manoeuvres was 131 (average per trip 4.2 ± 3.3) of which 75% were infraction to the code. The increases in the average number of catch-up manoeuvres per trip and in the percentage of infractions with respect to the total number of catch-ups were both statistically significant (Mann-Whitney, $p = 0.01$) and [$\chi^2(1, n = 165) = 13.51$, $p < 0.01$]. The number of infractions per trip increased from an average of 0.8 ± 0.7 in 2002 to an average of 3.1 ± 3.4 in 2004 (Mann-Whitney, $p < 0.01$) (this was calculated only for infractions #1 and

#2). The relative frequency of these two infractions did not change (2002, #1 = 47%, #2 = 53%; 2004, #1 = 38%, #2 = 62%) [$\chi^2(1, n = 115) = 0.41, p = 0.52$].

The average length of the boat-whale interaction was 22.1 min ± 9.0 min in 2002 and 20.9 min ± 8.5 min in 2004. These did not differ statistically (Mann-Whitney, $p = 0.59$). The average boat-whale distance in 2002 was 149.0 ± 65.9 m while in 2004 it was 116.5 ± 35.8 m. These were not statistically different (Mann-Whitney, $p = 0.11$). The average speed of the vessel was lower in 2004 than in 2002 (1.7 ± 0.9 knots versus 2.9 ± 1.1 knots; Mann-Whitney, $p < 0.01$) but the average number of increases in speed > 1 knot/min did not change (0.04 ± 0.04 versus 0.06 ± 0.04; Mann-Whitney, $p = 0.13$). The average number of course changes/min was higher in 2004 (0.55 ± 0.44) than in 2002 (0.24 ± 0.13) (Mann-Whitney, $p < 0.01$).

4.4 Discussion

The whale-watching Code of Conduct elicited mixed reactions from the tour boat industry in Newfoundland and Labrador. Only 40% of operators signed onto the code. Fewer than half of those who signed considered the code to be valuable to their business yet only 18% felt that changes should be made to the code. Operators did appreciate being included in the development of the code and considered the co-ordinating agencies – HNL and ATANL – to be the appropriate ones for the task. These two last factors were considered positive for the success of the Code of Conduct. Studies have in fact shown that an appropriate promoter and the involvement of all stakeholders in the decision-making process are important factors in developing successful voluntary measures (Clark, 1996; Scheyvens, 1999; Parsons and Woods-Ballard, 2003; Heckel *et al.*, 2003). The survey also revealed that all the operators considered the code easy to follow and the majority felt that no workshops were necessary to clarify the rules. Understanding guidelines and judging them to be fair have been shown to be good predictors of code compliance (Sirakaya and McLennan, 1998).

The survey showed that while some tour boat operators had noticed infractions to code guidelines, none of them filed complaints to ATANL. Only one operator directly confronted the owners of a vessel that breached the rules, but no other measures were taken. This lack of involvement of the tour boat operators in the enforcement of the rules is problematic, given that the strength of voluntary measures is usually based on a peer pressure mechanism (Gjerdalen and Williams, 2000).

The 2002 and 2004 studies showed that compliance with the code was low. The Code of Conduct was respected in only 31% (2002) and 23% (2004) of the trips, which is similar to what was reported by Scarpaci *et al.* (2003) for compliance with swim-with-dolphins activities in Australia (the only other study of this kind available).

Most infractions occurred because tour boat operators performed catch-up manoeuvres to approach whales. These manoeuvres consisted of changes in boat speed and course that allowed operators to reduce distance to the whales. Tour boat operators used these manoeuvres either to get within 100 m of the whales, or to remain within 100 m once they had entered the exclusion zone. In both scenarios, operators were committing infractions to the code.

The variability in the number of infractions per minute was best explained by the behaviour of different skippers (study 2004), while other factors such as number of passengers on board (2002), time of season, weather conditions, sea state (2002 and 2004), and whale behaviour (2004) did not play a significant role. In the 2002 study the variable 'skipper' was not included, and thus the finest level of analysis possible was 'vessel'. There were no differences in the number of infractions per minute, although differences in the number of course changes/min and in the length of boat-whale interaction were found due to one vessel/company (both positively correlated with the total number of infractions per trip). Interestingly, this company was the one that had a solitary skipper. Overall, the results suggest that it is indeed the 'modus operandi' of different skippers that most influences the likelihood to commit infractions.

Most skippers manoeuvred the boat to get close to the whales and were largely in control of the interactions. Indeed, the most common direction of whale movement was away from the boats. In these instances, the duration of the boat-whale interaction was longer, indicating that skippers were actively following the whales to maintain the interaction. Interestingly, in the cases where whales were more in control (i.e., swimming towards vessel or logging in the vicinity), the duration of the encounter was significantly shorter. In these circumstances, skippers usually did not follow the whales, likely because they considered these interactions to be satisfactory for the passengers.

Some temporal trends in the occurrence of infractions were noticed in 2004 (but not in 2002). Performing a catch-up manoeuvre to get inside the 100 m zone (infraction #1) was the most common type of infraction in the first part of the season. On the other hand, performing a catch-up when already within 100 m zone (infraction #2) was most likely to happen in mid season when whales tend to be more prevalent and spend more time feeding. Therefore, the likelihood of certain types of infractions changed during the season, which reflected the impression of the skippers. It must be remembered, however, that even if skippers were adapting their behaviour across parts of the season, some still committed more infractions than others, indicating that skippers should be able to respect the code regardless.

The comparison of code compliance between the 2002 and 2004 seasons revealed an increased number of infractions, number of catch-ups and proportions of infractions over the total number of catch-up manoeuvres in 2004. These results are important and somewhat worrisome as the tour boat operator in question was expected to be more respectful of the code rules in 2004, having had more time to learn and implement them. The operator in question has maintained the same skippers, the same vessels and the same trip schedules. To the author's knowledge, the behaviour of the whales has not shown any particular trends that would have made approaching the whales more difficult in 2004. Moreover, the average speed of the vessels was actually lower in 2004. This lowered compliance could be due to a variety of factors.

One possibility is that the tour boat operator has become more relaxed about the rules because as of yet, there have been no consequences for code violations. Results for other companies were not obtained in 2004, so it cannot, therefore, be determined if this was a general trend. The operator included in the study is, however, one that strongly endorsed the code. Thus, changes (for the worse) could also be happening in other companies that are less vocally supportive of the code. Pressure from passengers for a 'better' whale-watching experience seems an unlikely factor, as skippers did not commit more violations as the number of passengers increased.

Tour boat operators have been operating in the area for the last 20 years and during this time they have developed a personal and efficient method to approach whales, a method that is not compatible with the actual Code of Conduct. This method involves actively manoeuvring the boats to enter the 100 m exclusion zone. It is the author's belief that oftentimes when skippers commit infractions they are not aware of breaching the code. The presence of investigators on board should have prevented the skippers from being purposely intrusive and from repeatedly breaching the rules. Estimating distances at sea has proven to be difficult and this could have contributed to the failure to respect the 100 m rule, especially considering the fact that none of the skippers used range finders nor were previously trained to judge distances at sea (Baird and Burkhard, 2000). It is likely that all of the operators reported finding the code easy to follow because they were unaware of just how often they were actually in violation.

The Code of Conduct was introduced in Newfoundland and Labrador as a form of management for whale watching in anticipation of stricter regulatory measures, or in place of them if shown to be successful. Some tour boat operators have recognised the importance of the code for their business and for the protection of the whales, but they are not yet respecting the rules consistently.

Summary of results:

1) Only 40% of tour boat operators in Newfoundland and Labrador signed onto the Code.
2) Although operators surveyed claimed that the code was easy to follow, the Code of Conduct was only respected on 31% (2002) and 23% (2004) of trips.
3) A mechanism of peer-pressure among tour boat operators that could limit the number of infractions is not yet in place.
4) Tour boat operators, not the whales, controlled the interaction two-thirds of the time.
5) Different skippers committed different number of infractions regardless of environmental factors (weather and sea conditions), time of season or type of whale behaviour, and are therefore accountable for the infractions.
6) Getting too close to the whales, most commonly through catch up manoeuvres, was a common factor among all tour boat operators and all skippers.
7) Performing a higher number of catch-ups/min and sustaining longer interactions were associated with an increase probability of committing more infractions.

Chapter 5 – The effect of the Code of Conduct on the passengers

5.1 Introduction

After the establishment of the Code of Conduct in 2001, it became clear that at least four aspects of its implementation should be evaluated: passenger satisfaction, educational value of whale watching, the possibilities of passengers enforcing the code, and tour boat operator advertising.

The first issue was raised by the tour boat operators. Operators were worried that compliance with the code may affect passengers' satisfaction. Operators pointed out that maintaining distances required by the code when approaching whales could reduce the chances of close encounters with the whales and therefore diminish satisfaction with the trip. Passengers were asked to rate their satisfaction with their trip, to assign grades to a variety of contributing factors, to indicate whether their expectations had been fulfilled and whether the code limited their satisfaction. Responses were compared under different conditions.

The second issue was the educational benefits of whale watching. Despite the general consensus among international organisations, scholars, managers, and the tourist sector that whale watching should have an educational component (see section 2.4), in fact, to date there has been little research to test how much whale watchers actually learn during their trips. By signing onto the Newfoundland and Labrador Code of Conduct, operators committed to providing an accurate and informative interpretation program on board their vessels. This included conveying up-to-date information on whale biology, promoting conservation, and drawing attention to the special care that the marine environment deserves. The majority of the tour boat operators offered on-board interpretation programs. These were performed by hired interpreters or by the skippers. To examine the educational value of whale watching in Witless Bay, I looked at how much passengers actually learned during their trip. This was compared to the knowledge gained through more formal educational deliveries, such as exposing passengers to an educational video or a talk on the Code of Conduct and whale biology. In addition, I investigated passenger awareness of cetacean conservation issues and their intentions to get more involved in conservation (i.e., conative component of attitude), as intentions have been shown to predict whether learners will demonstrate environmentally responsible behaviour (Hwang et al., 2000).

The third area of concern was enforcement. Voluntary codes of conduct can be difficult to enforce because there tends to be a lack of specific mechanisms in place. For this reason, the Newfoundland and Labrador code was designed in such a way that passengers could express concerns over code violations. It was the operators' responsibility to inform passengers of this possibility and also to provide information on where to report infractions. Passengers' knowledge of the code and ability to report infractions were also directly investigated, by asking whale watchers to report if specific 'actions' (i.e. infractions to the Code of Conduct) had occurred during their trip. Finally, since the Code of Conduct for Newfoundland and Labrador was based on a 100 m rule, the ability of passengers to correctly estimate this distance on the water was tested.

Demographic data were also collected to determine the characteristics of the typical Newfoundland and Labrador whale watcher. Studies have in fact shown (see Chapter 2) that diverse locations attract different subsets of wildlife viewers (novice versus more experienced), which in turn may have an influence on environmental awareness, and predisposition and ability to report infractions.

The final issue was how realistic passengers' expectations are for whale-watching experiences and how operators influence those expectations through promotional materials. Advertising in brochures, TV or on the Internet often encourages unrealistic expectations, portraying activities such as getting close to, touching, taking spectacular pictures of, and feeding whales. Stemming from such expectations, operators may then feel pressured by tourists to get too close to the whales and to perform intrusive approaches. Operators who signed onto the code were committed to providing passengers with reasonable expectations about whale-watching experiences, through realistic advertising and by informing passengers of the constraints that the code imposes. To study this aspect, the advertisements of Witless Bay tour boat operators were reviewed.

5.2 Materials and Methods

To investigate passenger satisfaction, the educational value of whale watching, and passenger enforcement potential, questionnaires were developed and given to the passengers of commercial whale-watching boats in Witless Bay (2001-2004), and a video installation was set up in one of the operator's facilities (2004, a talk sometimes replaced the video). To investigate the consistency of tour boat operator advertising with code principles, six brochures and four websites from six companies in the Witless Bay area were reviewed (2004).

Questionnaire design

Questionnaires were handed out to passengers of the four main tour boat companies in Witless Bay during whale-watching seasons between 2001 and 2004 (four years in total). The questionnaires were designed to be clear for the passengers and to be easy to fill out in unfavourable sea and weather conditions. The questionnaire began with a brief outline of the study and its goals, and contact information was provided. The first section was for demographic information, followed by questions on the biology of humpback whales and on conservation issues (see Appendices D - G). Questions pertaining to passengers' satisfaction, knowledge of the Code of Conduct and impressions of the boat-whale interactions were also included.

At the beginning of the 2001 season, questionnaires were handed out on the wharf as customers disembarked. It soon became apparent, however, that this method was not the most effective. After the trip, people usually dispersed quickly and some tour boat operators were also concerned that recruiting people on the dock created an obstacle to the normal flow of passengers. Thus the methodology was changed and questionnaires were handed out on board whale-watching vessels. Usually, the tour boat operators introduced the study and the investigators to the passengers, and this fact, together with having more time available for filling out the questionnaires (during cruising time between the Ecological Reserve and the wharf), significantly increased the return rate.

Pre-trip questionnaires to gather baseline data for comparison were introduced in 2002. Questionnaires were handed out on the wharf or immediately after boat departure and before operator commentary. For each trip, different individuals filled out the pre- and the post-trip versions of the questionnaire so as to reduce the number of questions for each passenger and also to prevent a carry-over effect (Senn, 1992; Teisl *et al.*, 1995; Klentschy, 2001). Researchers collected the questionnaires immediately after passengers had completed them.

Questionnaire return and analysis

The total number of questionnaires collected was 1302 (522 pre-trip and 780 post-trip). The number of questionnaires collected for each specific year was 282 in 2001, 478 in 2002 (242 pre-trip and 236 post-trip), 120 in 2003 (69 pre-trip and 51 post-trip), and 422 in 2004 (211 pre-trip and 211 post-trip).

During these years, the focus of the questionnaires stayed the same, but some questions were replaced in order to investigate different aspects of the Code of Conduct. Two questions in the post-trip questionnaire (2001) also had to be reformulated: 1) was this your first whale-watching experience? 2) how many times have you been whale watching? Sometimes passengers answered *yes* to the first question, and *one* to the second (being unsure if the trip they were just disembarking from counted as one, which was asked to researchers on several occasions). In 2002, the two questions were replaced with a single one: how many times have you been whale watching '*before*'? It is unlikely that this procedure created a bias in determining the number of first timers, because results in 2001 were corrected in cases where answers to these two questions disagreed, with the first answer considered as the valid (i.e., clearer) response. In cases where passengers had been whale watching several times, I may have overestimated (+1) the number of previous whale-watching experiences for some passengers. Statistical analysis, however, showed that there were no differences in the number of previous whale-watching experiences among years (see below).

In analysing the results of the questionnaires, and for a matter of parsimony, results from questions that were asked in multiple years were pooled, after data were analysed for differences among years (no differences across years were found). For all questions, the years during which they were asked, the sample size, and the results of statistical analysis (for those asked in multiple years) are as follows: age (2002, 2003, 2004, n = 1005; ANOVA, F = 0.10, p = 0.90), sex (2002, 2003, 2004, n = 1006; $\chi^2 = 4.19$, df = 2, p = 0.12), place of origin (2002, 2003, 2004, n = 1015, $\chi^2 = 22.03$, df = 14, p = 0.08), origin within Canada (2002, 2003, 2004, n = 680, $\chi^2 = 24.78$, df = 18, p = 0.10), urban/rural areas (2002, n = 465), live by ocean (2002, n = 461), socio-economical index (2002, 2003, 2004, n = 714, ANOVA, F = 2.39, p = 0.09), education (2002, 2003, 2004, n = 949, $\chi^2 = 13.45$, df = 8, p = 0.09), previous number of whale-watching experiences (2001, 2002, 2003, 2004, n = 1279, ANOVA, F = 1.96, p = 0.11), subscribe to magazines (2002, 2003, 2004, n = 1018, $\chi^2 = 2.66$, df = 2, p = 0.26), which magazines (2002, n = 112), field equipment (2002, 2003, 2004, n = 1020, 4 items, χ^2 tests, df = 2, lowest p obtained = 0.37), what is the reason for the trip to NL (2002, n = 472), is whale watching part of the reason (2002, n = 447), how did you know about whale watching in NL (2002, n = 445), why are you going whale watching (2002, n = 437), are you involved in conservation (2003, 2004, n = 538, χ^2 = 1.81, df = 1, p = 0.17), what species will you see (2002, 2003, 2004, n = 378, χ^2 = 10.57, df = 6, p = 0.11), how close will you be from the whales (2002, 2003, n = 225, t-test, t = -1.14, df = 223, p = 0.25), comparison passengers exposed/non-exposed to advertising material (2002, n = 168), experience will be limited by the code (2002, n = 235), were you satisfied with your trip (2001, 2002, n = 489, χ^2 = 7.82, df = 4, p = 0.10), did the trip fulfil your expectations (2002, n = 231), what contributed most to the satisfaction of your trip (2002, n = 231), was the experience diminished by the code (2002, n = 25), do you think whale watching was educational (2001, n = 260), tests on knowledge of whale biology (2002, n = 478; 2003, n = 120), what are the main threats to the whales (2002, 2003, n = 590, χ^2 = 4.97, df = 2, p = 0.09), what are the main solutions (2002, 2003, n = 590 χ^2 = 1.16, df = 1, p = 0.28) will you be more involved in conservation in the future (2003, n = 114), would you donate $2 for whale research (2003, n = 110), are you aware of the code (2002, 2003, n = 596, χ^2 = 1.04, df = 1, p = 0.31), comparison of the number of infractions detected by the investigator and the passengers (2002, n = 88), comparison of passenger opinion regarding tour boat compliance in cases where the code was respected or violated (2002, n = 84), do you think the whales controlled the interaction with the tour boat (2001, 2002, n = 481, χ^2 = 4.58, df = 2, p = 0.10), presence of the vessel influenced behaviour of the whales (2001, 2002, $n = 460$, $\chi^2 = 2.77$, $df = 2$, $p = 0.35$), operator behaved in a respectful way toward the whales and the marine environment (2001, 2002, $n = 489$, $\chi^2 = 0.71$, $df = 2$, $p = 0.70$), do you know the rules of the code (2003, $n = 73$), would you report infractions (2002, 2003, $n = 289$, $\chi^2 = 0.30$, $df = 2$, $p = 0.93$), where would you report them (2002, 2003, $n = 123$, for both years none of the passengers knew where to report infractions), how close were you to the whales (2002, $n = 165$).

Passenger demographics and other characteristics of whale watchers

Collecting demographic data of the typical whale watcher in Witless Bay was important to determine how they compare to other locations where this activity occurs, and to test the feasibility of passengers as enforcers of the Code of Conduct. Requested information included age, sex, place of origin, education, place or residence (urban/rural, by ocean), and profession. A socio-economical index was calculated for each passenger, according to Blishen (1967; socio-economical index for professions in Canada; 25.36 - 76.69, index minimum - maximum). Students, retired and unemployed passengers could not be included in this analysis (20% of the total). Other questions included: the number of previous whale-watching experiences, if passengers subscribed to nature magazines (and which ones), what field equipment were they carrying with them, reasons for being in Newfoundland and Labrador (and if whale watching was one of them), how passengers had known about the possibility of going whale watching in this province, and if (and how) they were involved in environmental conservation.

Definitions for the profile of whale watchers were created according to the answers to Question 16 (2002; why do you want to go whale watching?), and were classified as detailed in Table 5.4.

Passenger expectations

Expectations were analysed in regards to which species passengers anticipated seeing and how far from them they hoped to be. It was considered accurate to expect to see the following local species: humpback, fin, and minke whales, white-sided and white-beaked dolphins, killer whales and harbour porpoises (although the likelihood of seeing each of these species varies, these answers were considered accurate because they are in agreement with reported whale sightings in the area). Inaccurate expectations included having generic expectations (e.g. seeing 'all species', 'all of them', etc.), mentioning species that are not commonly sighted in the area (e.g. sperm, blue, etc.) or not being able to mention any species at all. Passengers who were anticipating being less than 100 m from the whales were considered to have expectations in disagreement with the code.

Passenger satisfaction

Passengers were asked to rate their satisfaction with their trip (ranging from very dissatisfied to very satisfied; scored 1 to 4) and these ratings were compared under conditions of code compliance versus violation and when the distance to the whales was less than or greater than 100 m. In 2002, whale watchers were also asked to rate the importance to 15 different factors possibly contributing to the enjoyment of their trip (ranging from not important to extremely important; scored 1 to 5; see Table 5.5). Finally, passengers were asked to indicate whether or not their expectations had been fulfilled and whether or not their satisfaction with the trip had been limited by the code.

Educational value

In order to analyse the educational value of whale watching in Witless Bay, a test on whale biology was included in the 2002 (multiple-choice) and 2003 (open-ended) questionnaires to measure how much passenger learned during their trip. A General Linear Analysis to determine which factors were the most important in determining passengers' test score is presented for the 2003 study (in 2002, no significant results were found, probably due to a ceiling effect due to the multiple-choice nature of the test).

Biology questions (n = 5) selected for these tests, and acceptable responses, were chosen according to my personal experience on the subject, bibliographical information (Orams, 1997; Russell, 2002), and in agreement with the content of tour boat operators' interpretations in the area of study. These are presented in Appendix E (2002, questions 17 to 21) and in Appendix F (2003, 11 to 15). The results of the tests are presented as percentages of passengers providing the right answer for each specific question. The overall test score is also presented. This was calculated for each passenger by assigning one point for each correct answer; results were then averaged across experimental groups.

Environmental awareness

To test if taking part in a whale-watching trip in Witless Bay raised environmental awareness, passengers were asked to identify specific threats to the whales and to provide some possible solutions. Responses were considered to be correct according to my personal experience on the subject. Passengers were also asked if (and how) they would be more involved in conservation in the future. Finally passengers were asked if they would agree to pay $2 on top of their ticket in the future as a donation to whale research.

Enforcement of the Code

In order to investigate the feasibility of a passenger-enforced Code of Conduct, awareness of the code pre- and post-trip was investigated. To test if they were able to detect code infractions, passengers were asked to judge operator behaviour and to determine if the skipper had performed any of the following 'actions': (1) getting closer than 100 m to a whale on purpose, (2) approaching a whale when already engaged by two other vessels, (3) pursuing or chasing a whale, (4) not reducing speed when the whale was within 100 m, and (5) approaching a whale directly from the front or from the side. These data (2002) were compared with investigator observations. Due to the fact that the Newfoundland and Labrador code is based on a 100 m rule, in 2002 passengers (n = 165) were also asked to estimate the closest distance they had been to the whales during their trip. These estimates were compared with range finder fixes taken by the investigators.

Passengers also gave their opinion on who controlled the boat-whale interaction (boat or whales) and if they thought the operator had been respectful of the whales and the marine environment. Finally, passengers indicated whether or not they would report infractions and if they knew where to report them.

Video and educational talk

In 2004, I investigated the effects of formal educational interventions on the educational experience of whale watching in Newfoundland and Labrador and how these compared to the educational outcomes of simply going on a whale-watching trip. Between July 10th and August 10th, 907 passengers were exposed to either a pre-trip educational video (n = 403) or to an informative talk (n = 504). Maxance Jaillet, through a Newfoundland Independent Filmmakers Cooperative (NIFCO) project and in collaboration with the Whale Research Group, created a video entitled *Of Vessels and Spouts*. The video, with a running time of 7.5 min and consisting of video footage and animation, provided detailed information on the biology, ecology and conservation of humpback whales and on the specific rules of the Code of Conduct (a DVD copy of the video is available upon request). A video installation was set up at the wharf, in the premises of one of the tour boat operators. Research assistants approached passengers waiting to embark on the boats and invited them to watch the video.

After the screening, researchers outlined the study and asked some of the passengers to fill out the questionnaires (Appendix G, relevant questions are: 11-14 for knowledge of whale biology, 15-17 for knowledge of the Code of Conduct, total n = 7). The same procedure was followed for the talk, which provided the same information as the video and was of the same length. There was no pre-determined order for the deliveries. The decision to expose passenger to the video or the talk was circumstantial, and depended on the availability of the premises, timing, trip schedule, and weather conditions. Skippers (n = 5) of the company that took part in the study were provided with the same information and asked to incorporate it into their interpretation. This allowed for a comparison of the educational efficacy of the three different delivery methods.

For this study, passengers were randomly divided into 6 different groups. Three groups completed the questionnaires before the trip: 1) pre-trip passengers not exposed to any educational delivery (n = 67); 2) pre-trip passengers exposed to the video (n = 67); and 3) pre-trip passengers exposed to the talk (n = 77). Three groups completed the questionnaires after the trip: 4) post-trip passengers only exposed to the interpretation on board (n = 87); 5) post-trip passengers exposed to the interpretation on board and to the pre-trip video (n = 64); and 6) post-trip passengers exposed to the interpretation on board and to the pre-trip talk (n = 60).

It seems unlikely that there was a bias towards already-environmentally-concerned passengers self-selecting into the formal education groups given the following: passenger participation in the educational deliveries was extremely high (roughly over 90% of those asked, and everyone at the wharf before the educational session began was invited to take part); ‘control group’ participants (i.e., groups 2 and 4) were most commonly passengers that arrived at the wharf after the educational programs had begun or passengers approached on days in which the educational deliveries were not performed due to circumstantial reasons (e.g., unavailability of the premises, trip schedules or problems with the video), not those who opted out of participation in the formal education.

Tour boat advertising

In 2004, I analysed the advertising of the tour boat operators working in Witless Bay. This was done to determine whether or not these companies tend to provide customers with reliable expectations. Six tour boat businesses were included in the study (the four bigger operations plus two smaller ones). Six brochures and four websites were used for analysis (all that were available). For each tour boat company, materials were examined to see whether or not the Code of Conduct was introduced, its rules explained, and the 100 m exclusion zone mentioned. Also noted were cases where operators used pictures depicting boats and whales very close together (seemingly within 100 m), or enticing pictures of animals engaged in spectacular aerial behaviour. Instances where operators publicised rare species or emphasised spectacular encounters were also recorded. According to my judgement and experience in the area of study, these were considered to provide 'unrealistic expectations' to the passengers (i.e., events unlikely to happen on an average trip; some species mentioned, for example, have *never* been encountered in the area during the 5 year-study and more than 300 trips at sea). Finally, any mention by the operators of their commitment to education and environmental conservation was noted.

Statistics

For statistical analysis of frequency data χ^2 tests were used. For analysis of interval data, t-tests and one-way ANOVA were used. Passengers' score on the biology and Code of Conduct tests were also analysed with Univariate GLM to identify contribution to the general variability by several independent variables (subjects). When subjects' contributions were significant, I utilised Tukey's Honest Significant Difference post-hoc test (Tukey's HSD) to investigate differences in between-subject factors (Tukey, 1986). Spearman's coefficient rho was calculated to investigate correlation between variables. The statistical package used for data analysis was SPSS 12.0.1 (SPSS Inc., 1989-2004). The level of confidence assumed was 95%. Means and standard deviations were usually used as descriptive statistics, but estimates of distance and number of previous whale-watching experiences were presented with medians (25 – 75, percentiles) to minimise the effects of extreme values. Percentages are usually reported with two significant figures, although sometimes three figures are presented when it was necessary to add up to 100%.

5.3 Results

5.3.1 Passenger demographics

The average age of passengers was 45 ± 15 years. Fifty-six percent of passengers were female and 44% were male. Table 5.1 presents the place of origin of the passengers that filled the questionnaires. Most of passengers were Canadians (70%), while 18.2% came from the United States. Within Canada the highest percentage of passengers was from Ontario (48.9%), with those from Newfoundland and Labrador being the second highest (25.4%).

Table 5.1: Place of origin of whale-watching passengers in Newfoundland and Labrador.

COUNTRY (or CONTINENT)	%		WITHIN CANADA	%
	(n = 1115)			(n = 680)
Canada	70.3		Ontario	48.9
USA	18.2		Newfoundland and Labrador	25.4
Germany	2.6		Alberta	6.9
UK	2.6		British Columbia	4.9
Other European Countries	3.5		Quebec	4.8
Oceania	1.0		New Brunswick	3.3
Asia	0.76		Nova Scotia	3.0
Africa	0.76		Manitoba	1.2
Other	0.28		Saskatchewan	0.90
			Prince Edward Island	0.70

Seventy-one per cent of passengers lived in urban areas while 29% were from a rural area. Twenty-three per cent of whale watchers lived by the ocean.

The average score on the socio-economical index was 58.17 ± 15.36. The most represented occupations were in the educational, medical, technical and managerial sectors (Table 5.2a). Sixty-four per cent of passengers had some sort of post-secondary education (Table 5.2b).

Table 5.2: Occupation and level of education of whale-watching passengers in Newfoundland and Labrador.

OCCUPATION (a)	%		EDUCATION (b)	%
	(n = 714)			(n = 949)
Educational	15.6		Bachelor	35.2
Medical	11.8		High School	34.6
Technical	8.5		Master	15.3
Managerial	7.5		College	7.0
Manual	5.8		PhD	6.9
Engineering	4.7		Under grade 12	1.0
Administrative	4.6			
Scientific	4.6			
Financial	4.5			
Law	4.3			
Self employed	4.2			
Clerical	4.1			
Sales	4.1			
Civil servant	3.9			
Artist/creative	3.0			
Consultant	1.8			
Tourism	1.4			
Counseling	0.86			
Environment	0.54			
Other	4.2			

5.3.2 Passenger expertise and other characteristics of whale watchers

Forty-three per cent of passengers were going whale watching for the first time. For those that had gone before, the median number of previous whale-watching experiences was 2 (1 - 4, first and third quartiles). Twenty-eight per cent of passengers subscribed to nature magazines at home, with Canadian and National Geographic being the most common (a combined 60% of the total).

Ninety per cent of the passengers had a camera with them, 44% had binoculars, 17% had a field guide and 14% had a video camera.

Seventy-five per cent of passengers were on vacation, 15% were local residents, 5.8% were on a business trip, 1.2% were visiting family and 3.0% had other reasons for being in the province.

Only 4.3% of the visitors had come to Newfoundland and Labrador specifically to go whale watching, while 60% of them noted whale watching as one of the reasons they had come.

Most commonly, passengers learned about the possibility of going whale watching in Newfoundland and Labrador through word of mouth (27.2% of cases; Table 5.3). Tourist information material (21.7%) and travel books (12.5%) were also important sources. Other factors included being a resident of the province, advertisements, the Internet, television, tour guides, and having been in Newfoundland and Labrador before.

Table 5.3: How passengers learned about the possibility of going whale watching in Newfoundland and Labrador.

HOW PASSENGERS LEARNED ABOUT WHALE WATCHING IN NL	%
	(n = 445)
Through word of mouth	27.2
From tourist information material (brochures, posters, etc.)	21.7
From travel books	12.5
By being a resident of the province	10.9
From advertisements (not specified)	5.2
From the Internet	3.4
From television	2.9
It was in their general knowledge	2.3
They had been in Newfoundland before	2.0
From the media (not specified)	1.6
They were born in Newfoundland	1.6
From the tour guide	1.6
From magazines	1.3
They had just found out	0.90
It was part of their travel package	0.90
Other reasons	4.0

Table 5.4 presents a breakdown of the reasons why passengers wanted to go whale watching. The most common motives were 'romantic' (15.2%), having to do with the fascination and wonder of the animals. Going whale watching for pragmatic reasons was the second most common motive (13.8%), followed by naturalistic interests (12.5%) or just for entertainment (11.7%). Eleven per cent of passengers wanted simply to see the animals and the same percentage wanted to go because they had never done it before. Other reasons included: education (9.7%), adventure (5.9%), bird watching (3.8%), for the whole experience (2.5%), photography (1.1%), for the boat ride (1.1%) and iceberg viewing (0.7%).

Table 5.4: Passengers' reasons for going whale watching in Newfoundland and Labrador (categories created by investigator after the results were obtained).

CATEGORY OF WHALE WATCHERS	%	PASSENGERS' REASONS FOR GOING WHALE WATCHING IN NL (n = 437)
Romantic	15.2	Amazed by wildlife; amazing animals; awesome; close to nature; cool animals; experience their magic; fascinated by whales; feeling of huge intelligent animals; for their beauty; in awe of whales; incredible animals; it's like a dream; love nature; love of the ocean; love whales; see in person amazing creature; see the whales and hear them singing; see them free; spectacular animals; spiritual experience; observe a pinnacle of unspoiled nature.
Pragmatic	13.8	To bring friends; family trip; for the kids; good place to go; good weather; NL noted for whale watching; nice weather; on vacation; part of the tour; part of work; rare opportunity; recommended; school trip; show visitors; taking family; whales are there; for tourism.
Naturalist	12.5	Concern about the loss of species; enjoy wildlife; appreciate their size; interest in environment; interest in marine life; interest in nature; interest in wildlife; interesting species; like natural things; like water and nature; naturalist; ocean and nature; see a rare animal; see an endangered mammal; see local species; see nature; see whale behaviour; see whales in natural environment; see wildlife in natural habitat.
Entertainment	11.7	Enjoyment; entertainment; fun; for pleasure and relax.
See whales	11.0	
First timers	11.0	Always wanted to go; curious; for the experience; never been before; never seen whales before.
Didactic	9.7	Education; interest.
Adventurous	5.9	For the adventure; exciting; for the thrill.
See birds	3.8	
Whole experience	2.5	To see puffins and icebergs; to see puffins and whales; to see whales and birds; to see whales and boat ride; to see whales and icebergs; to see whales, for the ocean and birds.
Photography	1.1	
Boating lover	1.1	Enjoy boating.
See icebergs	0.70	

Forty-five per cent of passengers described themselves as involved in environmental conservation. Involvement consisted of: composting and recycling (49%), adopting responsible life-styles (18%), joining conservation groups (14%), giving donations (11%), working in the conservation field (4.8%) and raising awareness (3.2%).

5.3.3 Passenger expectations

The results of the pre-trip questionnaire showed that 68.3% of passengers were able to correctly identify local cetacean species (i.e., species consistent with reported whale sightings in the area) (Fig 5.1). Conversely, 31.7% had inaccurate expectations, including having generic expectations (e.g. 'all species', 15.2%), mentioning species that are not commonly sighted in the area (6.5%), or not being able to list any species at all (10%).

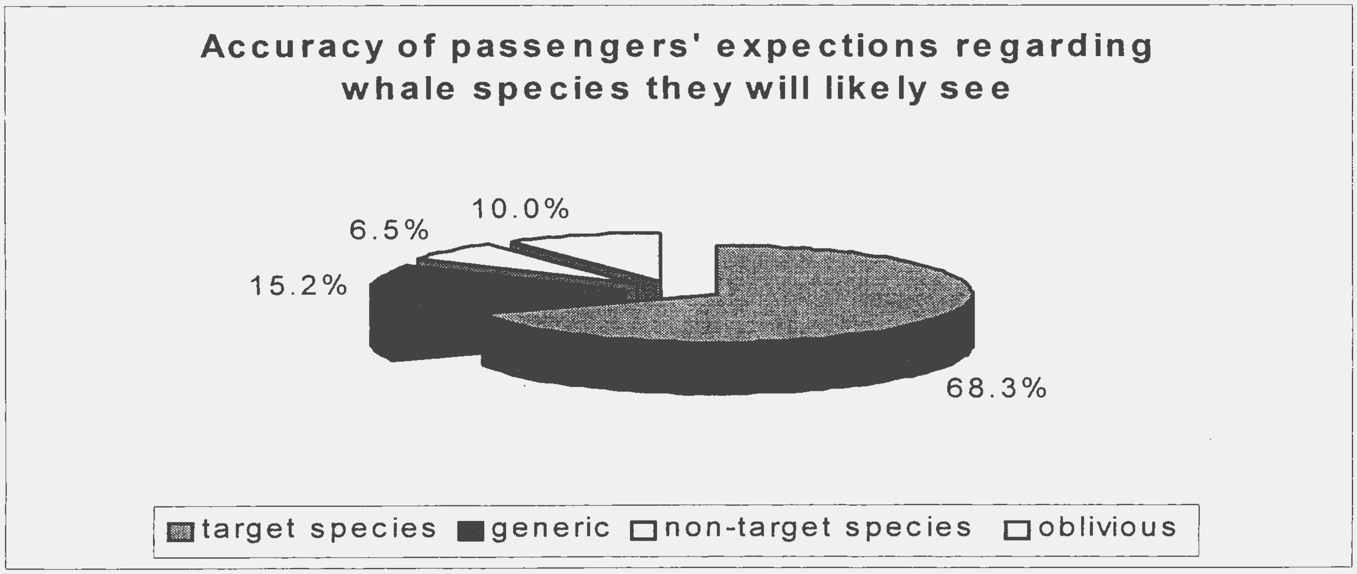

Fig. 5.1: Passengers' expectations of species they will likely see (n = 378).

Only 20.8% of passengers had expectations that were consistent with code guidelines regarding the distance they would be from the whales (i.e. > 100 m) (Fig. 5.2). Seventy-two per cent thought they would be within 100 m, while 7.2% could not give an estimate. The median distance estimated by passengers was 20 m (8 - 50, first and third quartiles, n = 168). Passengers exposed to tour boat advertising material (n = 57) had similar expectations to those not exposed (n = 111; Mann-Whitney, p = 0.43).

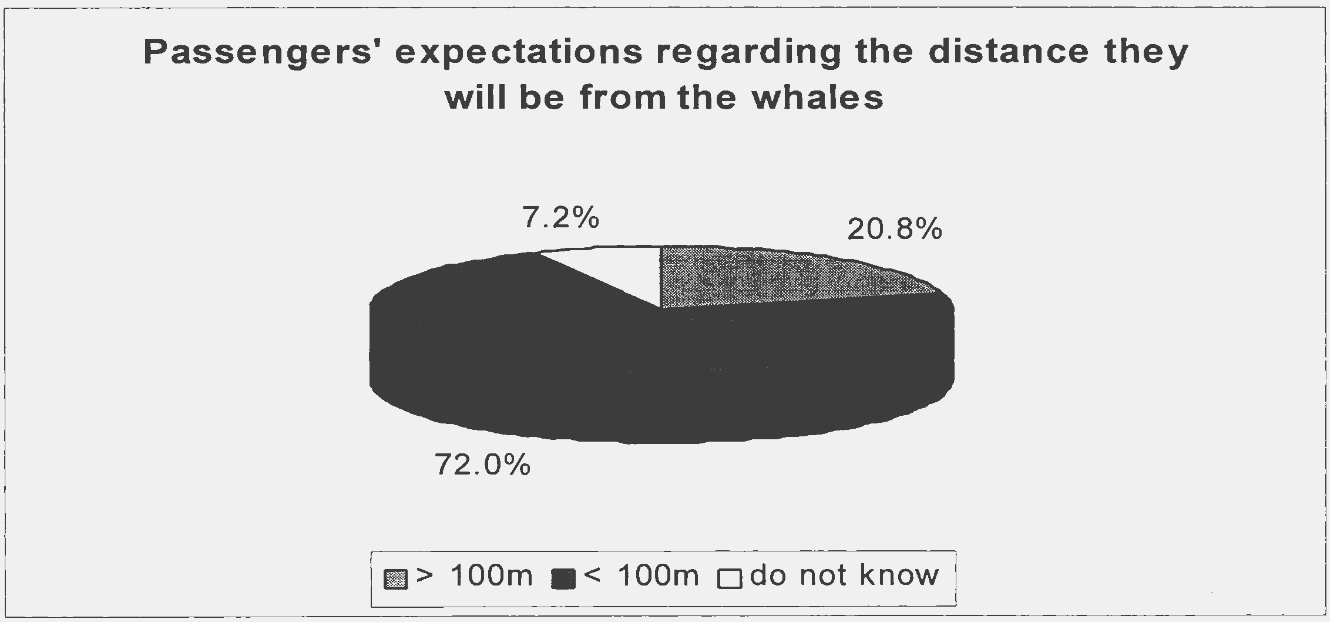

Fig. 5.2: Passengers' expectations regarding the distance they will be from the whales (n = 225).

Prior to the trip, 66% of passengers did not think the code would limit their whale-watching experience, 7.0% thought it would, and 27% did not know.

5.3.4 Passenger satisfaction

After the trip, 72% of passengers described themselves as very satisfied with their tour boat experience, 26% as satisfied, 1.0% as dissatisfied and 1.0% as very dissatisfied. Ninety-six per cent of passengers stated that their expectations had been fulfilled. Table 5.5 presents a breakdown of the factors that most influenced passenger satisfaction.

Table 5.5: Importance assigned by passengers to factors contributing to trip satisfaction in Newfoundland and Labrador (1 = not important to 5 = extremely important). Results included in different subsets are statistically different (ANOVA, $F = 89.7$, $p < 0.01$, Tukey's post hoc test, $p < 0.05$).

CATEGORY	N	IMPORTANCE ASSIGNED (value range = 1 to 5)						
		Ave ± SD						
		Subset 1	Subset 2	Subset 3	Subset 4	Subset 5	Subset 6	Subset 7
Refreshment on board	209	1.77 ± 1.03						
Seeing the seals	129	2.11 ± 1.19	2.11 ± 1.19					
Entertainment	212		2.33 ± 1.23					
Music on board	220		2.43 ± 1.22	2.43 ± 1.22				
Seeing the icebergs	141			2.76 ± 1.37				
Comfort of the boat	223				3.26 ± 1.04			
Seeing the birds	217				3.36 ± 1.12	3.36 ± 1.12		
Skill of interpreters	204				3.55 ± 0.99	3.55 ± 0.99	3.55 ± 0.99	
Weather	218				3.56 ± 1.07	3.56 ± 1.07	3.56 ± 1.07	
Information provided	210				3.57 ± 0.92	3.57 ± 0.92	3.57 ± 0.92	
Boat ride	224				3.59 ± 1.01	3.59 ± 1.01	3.59 ± 1.01	
Getting close to whales	229				3.61 ± 1.04	3.61 ± 1.04	3.61 ± 1.04	
Scenery	220					3.71 ± 0.93	3.71 ± 0.93	
Adherence to the code	208						3.76 ± 1.04	
Seeing the whales	231							4.23 ± 0.86
Sig.		0.08	0.14	0.13	0.07	0.06	0.81	1.00

Seeing the whales was considered the most important factor contributing to customer satisfaction. Other important factors included: operator adherence to the Code of Conduct, the scenery, getting close to whales, the boat ride, the information provided, the weather, skills of the interpreters, seeing the birds, and the comfort of the boat. Seeing icebergs, entertainment and music on board, seeing seals, and refreshments on board were not considered as important.

In the post-trip survey, for the 12 trips in which the code was actually respected, 79% of passengers stated that their experience had not been diminished by the fact that the operator adhered to the Code of Conduct, 13% were not able to judge, and 8.0% said that it had been diminished. It is interesting to note that when operators were in violation of the code, passengers' satisfaction did not increase [average for trips in compliance = 3.68 ± 0.38 (n = 12), average for trips in violation = 3.74 ± 0.61 (n = 27); t (37, n = 39) = - 0.32, p = 0.74], nor did it make a difference to be within or further than 100 m from the whales [average for trips < 100 m = 3.76 ± 0.57 (n = 35); average for trips > 100 m = 3.87 ± 0.25 (n = 4); t (37, n = 39) = - 0.38, p = 0.70]. Overall, no correlation was found between the distance of the approach (median = 40 m; range 10 – 238 m) and passenger satisfaction (n = 39, Spearman rho = 0.05, p = 0.74).

5.3.5 Effects of whale watching on passengers' knowledge of whale biology

In the 2001 survey, 92% of passengers considered their whale-watching trip to be an educational experience (n = 260). In 2002 and 2003, passengers of tour boats were presented with a test on whale biology in order to determine how much knowledge they actually acquired on the trip. The results presented in Table 5.6 show that in 2002 passengers only gained knowledge regarding one of the questions that was asked, about the food of humpback whales in Newfoundland and Labrador (+ 8.3%) [χ^2 (1, n = 478) = 5.80, p = 0.01]. Knowledge in the other subjects showed a non-significant decrease. Passengers' overall test score also showed a non-significant decrease (- 1.4%) [t (476, n = 478) = 0.34, p = 0.73].

Table 5.6: Comparison of biological knowledge, pre and post-trip (year 2002).

2002 Test (multiple choice)	Whales are mammals	11, 000 humpbacks live in the North Atlantic	50 years is the life-span of humpbacks	Male humpbacks Sing	Humpbacks main food in NL is capelin	Average test score ± SD Range (0-5)
Pre-trip (n = 242)	99.1%	38.8%	53.3%	19.4%	78.5%	2.87 ± 1.06
Post-trip (n = 236)	96.5%	33.1%	49.7%	19.1%	86.8%	2.83 ± 1.00
χ^2 (1, n = 478)	3.83	1.65	0.59	0.01	5.80	
t (476, n = 478)						0.34
p value	0.06	0.19	0.44	0.92	*0.01*	0.73

In 2003 more passengers were again able to identify the staple food of humpback whales in Newfoundland and Labrador after the trip (+ 19%) [χ^2(1, 120) = 4.28, p = 0.03]. Knowledge in the other subjects did not increase significantly. Passengers' overall test score showed a marginal non-significant increase (+ 22%)[t (118, n = 120) = - 1.77, p = 0.07] (Table 5.7).

Table 5.7: Comparison of biological knowledge, pre and post-trip (year 2003).

2003 Test (open-ended)	Whales are mammals	11, 000 humpbacks live in the North Atlantic	50 years is the life-span of humpbacks	Humpbacks use sound to communicate	Humpbacks main food in NL is capelin	Average test score ± SD Range (0-5)
Pre-trip (n = 69)	66.7%	0%	14.5%	40.6%	30.4%	1.52 ± 0.94
Post-trip (n = 51)	68.6%	0%	11.8%	56.9%	49.0%	1.86 ± 1.14
χ^2 (1, n = 120)	0.05	-	0.18	3.11	4.28	
t (118, n = 120)						-1.77
p value	0.82	-	0.66	0.07	*0.03*	0.07

The results of the Univariate GLM presented in Tables 5.8 and 5.9 show that the most important factors in determining passengers' score on the biology test (year 2003) were the tour boat company selected by the tourist for the trip (p = 0.02), whale watchers' level of education (p = 0.02), and passengers' number of previous whale-watching experiences (p = 0.02). These three factors were more important than actually taking part in the whale-watching trip (questionnaire pre/post). Other factors such as socio-economic status, involvement in conservation, gender, and place of origin also played a lesser role.

Table 5.8: Univariate GLM for passengers' score on the 2003 biology test, between-subjects factors.

SUBJECTS	BETWEEN-SUBJECTS FACTORS	N
Age	Range: 20 – 79	97
Socio-economical status	Range: 29.71 - 76.69	97
Involvement in conservation	Yes	48
	No	49
Tour boat company	1	20
	2	12
	3	18
	4	47
Gender	Males	41
	Females	56
Place of Origin	Newfoundland and Labrador	16
	Canada	51
	Other countries	30
Education	Under grade 12	3
	High School	19
	College	18
	Bachelor	34
	Master	20
	PhD	3
Number of previous whale-watching experiences	0	39
	1	28
	2 – 5	24
	> 5	6
Questionnaire	Pre	50
	Post	47

Table 5.9: Univariate GLM for passengers' score on the 2003 biology test, between-subjects effects.

Dependent variable: PASSENGERS' SCORE ON THE BIOLOGY TEST (n = 97)

Source	Type III Sum of Squares	Df	Mean Square	F	p value
Corrected Model	108.15	77	1.405	2.02	0.04
Intercept	26.33	1	26.33	37.93	<0.01
Age	46.02	39	1.18	1.70	0.11
Socio-economical status	14.33	18	0.79	1.15	0.38
Involvement in conservation	2.67	1	2.67	3.85	0.07
Tour boat company	***9.20***	***3***	***3.06***	***4.42***	***0.02***
Gender	2.07	1	2.07	2.98	0.10
Place of origin	3.56	2	1.78	2.56	0.10
Education	***11.17***	***4***	***2.79***	***4.02***	***0.02***
Number of previous whale-watching experiences	***8.45***	***3***	***2.81***	***4.06***	***0.02***
Questionnaire (pre/post)	0.52	1	0.15	0.22	0.67
Company * questionnaire (pre/post)	0.43	3	0.14	0.21	0.89
Error	13.19	19	0.69		
Total	478.00	97			
Corrected Total	121.34	96			

The average test-score for the 2003 biology test for passengers who chose different tour boat companies ranged from a minimum of 1.67 ± 1.06 to a maximum of 2.72 ± 0.99. The average test scores for passengers by educational level and number of previous whale-watching experiences are represented in Figures 5.3 and 5.4 respectively.

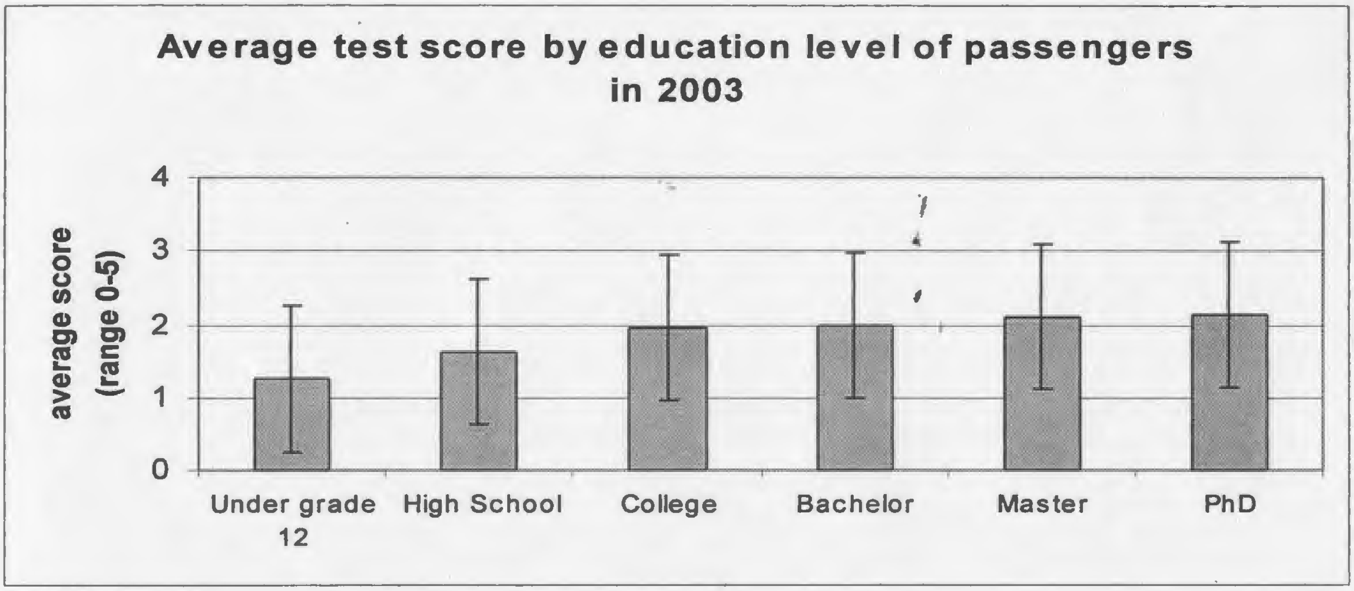

Fig. 5.3: Average score on the biology test by educational level of passengers of whale-watching boats in year 2003 (n = 97).

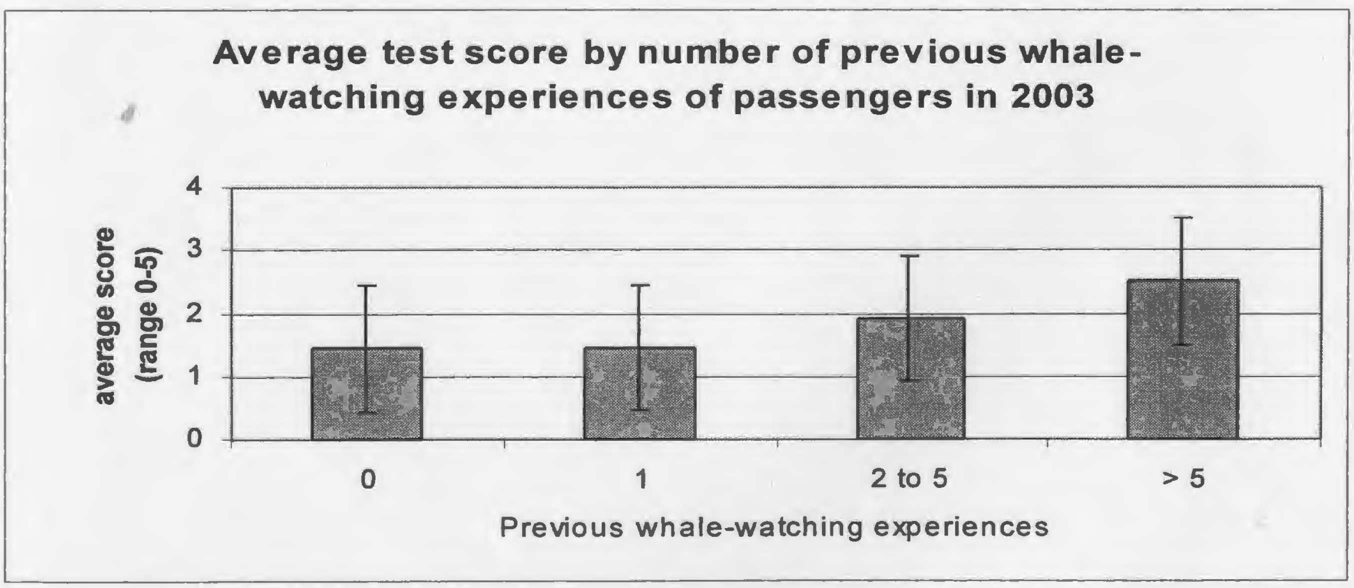

Fig. 5.4: Average score on the biology test by passengers' level of whale-watching experience in year 2003 (n = 97).

5.3.6 Effects of whale watching on passengers' knowledge of conservation issues and on environmental attitude

In the pre-trip questionnaires, 45% of passengers identified a specific threat to the whales, while 17% indicated more generally that 'man' was the biggest threat and 38% did not identify any threat at all. In the post-trip questionnaire, these percentages were respectively 38%, 24% and 38%. The decrease in those who identified specific threats approached statistical significance [χ^2 (2, n = 590) = 5.41, p = 0.06]. Overall, the most commonly identified specific threats were: pollution (22.9%), fishing (21.8%), whaling and hunting (9.2%), boating (8.2%), food shortage (6.8%), loss of habitat (2.0%), and other threats (2.5%). In 26.6% of the cases passengers mentioned more than one of the above threats.

When asked to provide solutions to the aforementioned threats, 44% of passengers were able to do so before the trip. After the trip this percentage was 40%, a change that was not statistically significant [χ^2 (1, n = 590) = 1.06, p = 0.30]. The most common solutions offered included: education and awareness (21.3%), restrictions and enforcement (19.8%), preserving and respecting natural habitats (12.7%), taking action and boycotting (11.2%), reducing pollution (10.8%), giving support and donations (9.3%), limiting the impact of fisheries (4.1%), and doing research (1.9%). In 8.9% of the cases passengers provided more than one of the above solutions.

Before the trip, 43% of passengers stated that they would be more involved in conservation in the future, 31% said they would not and 26% did not know. After the trip, these percentages were respectively 49%, 35% and 16%. No statistical differences were found [χ^2 (2, n = 114) = 3.27, p = 0.19]. These percentages also did not change for passengers that had never been involved in conservation before [χ^2 (2, n = 75) = 3.36, p = 0.19] or for beginner whale watchers [χ^2 (2, n = 62) = 2.40, p = 0.30].

In both the pre- and the post-trip questionnaires, 29% of passengers provided a specific way they would get involved in conservation issues in the future. These included: education and raising awareness (25.7%), change in life-style (14.3%), giving more financial contributions (14.3%), helping protect the environment (14.3%), volunteering (14.3%), changing type of transportation (5.7%), providing moral support (5.7%), and studying environmental subjects (5.7%).

The percentage of passengers that would donate $2 for whale research did not change statistically between the pre- (78%) and the post-trip test (87%) [χ^2 (1, n = 110) = 1.61, p = 0.20].

5.3.7 Passenger knowledge of the code and ability to report infractions

The percentage of passengers aware of the Code of Conduct increased from 70% before the trip to 84 % after the trip [χ^2 (1, n = 596) = 17.35, p < 0.01].

To test if passengers were able to detect code infractions, violating actions noticed by the whale watchers were compared with those identified by the investigators. The statistical analysis indicated that the frequency of passengers reporting infractions was independent of whether infractions actually occurred or not [χ^2 (1, n = 88) = 0.26, p = 0.60] (Table 5.10).

Table 5.10: Comparison between infractions identified by the investigator and by passengers.

		PASSENGERS IDENTIFIED INFRACTIONS	
	n = 88	Yes	No
INVESTIGATORS IDENTIFIED INFRACTIONS	Yes	46%	54%
	No	40%	60%
	Total	44%	56%

In cases where the operators breached the code, 85% of passengers thought that the operators had respected the code (Table 5.11). Passenger opinion was independent of whether the tour boat operator actually respected or violated the code [χ^2 (2, n = 84) = 0.42, p = 0.81]. In 85.7% of all cases passengers believed that the tour boat operator had been respectful of the code.

Table 5.11: Comparison of passenger opinion regarding tour boat compliance in cases where the code was respected or violated.

		PASSENGER OPINION ABOUT TOUR BOAT COMPLIANCE WITH THE CODE		
	n = 84	Yes	No	I don't know
COMPLIANCE WITH THE CODE	Yes	87.1%	0.0%	12.9%
	No	85.0%	1.8%	13.2%
	Total	85.7%	1.2%	13.1%

A benign view of the boat-whale interaction is also confirmed by the fact that 70% of passengers believed that the whales were in control of the interaction with the boats, 11%

thought the boats were in control, and 19% were not able to tell. Fifty-six per cent of passengers thought that the boat had not influenced whale behaviour, 26% thought that it had and 18% were not able to judge.

Overall, when asked whether the operator had been respectful of the whales and of the marine environment, 98% of passengers said yes, 1.0% said no, and 1.0% were not able to judge.

When passengers were asked if they would report infractions, 43.6% said they would, 8.7% said they would not and 47.7% were not sure. After the trip, however, 58% of passengers admitted still not knowing the specific rules of the Code of Conduct and none of them was aware that ATANL is the designated agency for reporting infractions.

5.3.8 Passenger ability to judge distances in the water

When asked to judge the boat-whale distance, 50% of the passengers estimated that the whales were closer than they actually were, 23% thought they were further, and 27% judged the distance correctly. Fig. 5.5 shows a comparison between the line of best fit for passenger estimates ($y = 0.9438\ x - 1.9788$, $R^2 = 0.25$) and the line representing the correct estimates (measured = estimated, $y = x$). The graph shows that the general tendency for passengers was to underestimate the boat-whale distance.

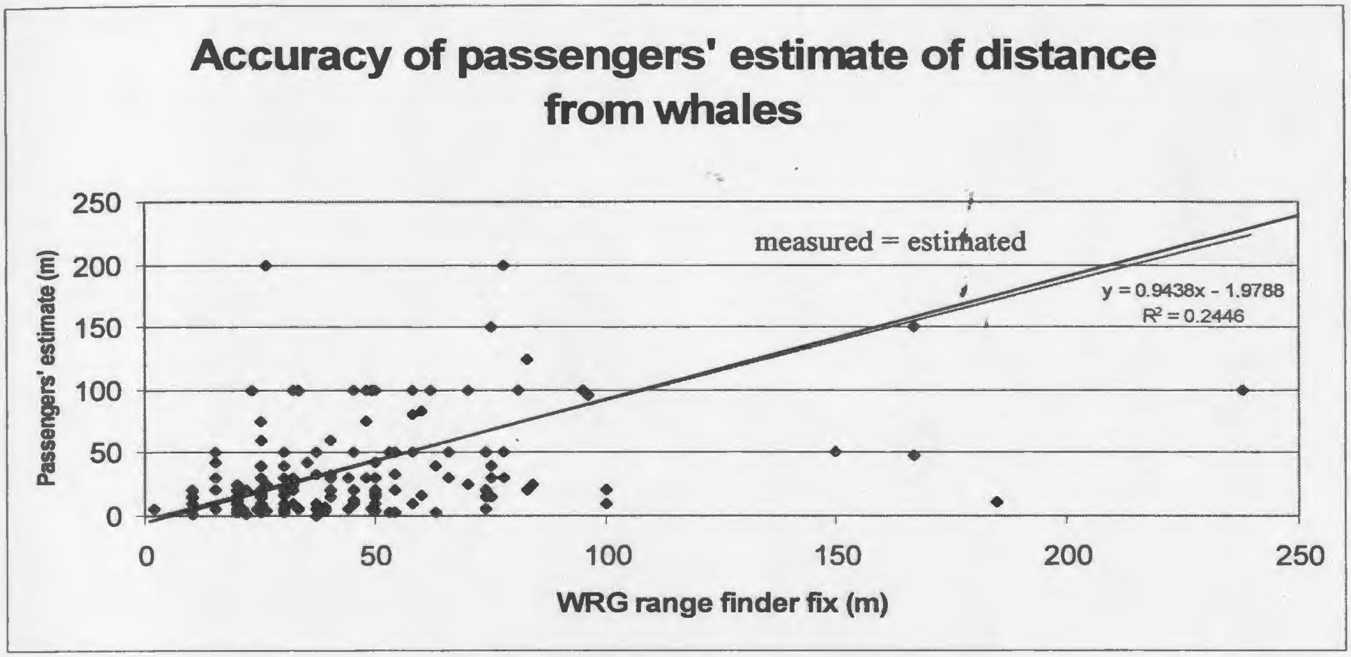

Fig. 5.5 Accuracy of passenger estimates of distance (n = 165).

5.3.9 Effects of formal educational interventions (2004)

The total number of passengers included in this specific study was 422 (211 pre-trip and the same number post-trip). The six groups and the number of passengers included in each group are presented in Table 5.12. (In some occasions, passengers left blank answers, therefore missing cases were not included in the GLM and Chi-square analysis; the sampling numbers available for each analysis are indicated).

Table 5.12: Experimental design and sample sizes during 2004 study.

QUESTIONNAIRE (Total n = 422)	NO EDUCATIONAL INTERVENTION	EXPOSED TO THE PRE-TRIP VIDEO	EXPOSED TO THE PRE-TRIP TALK
PRE-TRIP (n = 211)	1 (n = 67)	2 (n = 67)	3 (n = 77)
POST-TRIP (n = 211)	4 (n = 87)	5 (n = 64)	6 (n = 60)

The average score on the knowledge test was 4.87 ± 1.86 (the maximum score for the test is 7). The Univariate GLM showed that passenger experimental group was the most important factor in determining test scores ($p < 0.01$). Other factors such as gender, age, place of origin, socio-economical status, education, number of previous whale-watching experiences and previous involvement in conservation issues did not play a significant role (Tables 5.13 and 5.14).

Table 5.13: Univariate GLM for passengers' score on the biology and

Chapter 6 – The effects of the Code of Conduct on the whales

6.1 Introduction

The effect of human and vessel presence on whales has been studied for different species and different locations. Experts now agree that vessel proximity and certain vessel activities can lead to harassment of whales and to behavioural disturbance. Moreover, if impacts are repetitive, concentrated in biologically important habitats, and targeted at specific portions of populations, it is possible that long-term consequences for animal fitness may occur. Such long-term effects, however, have yet to be demonstrated and more systematic, empirical information and baseline data are needed.

Canada is committed to managing marine resources using a precautionary approach in order to take appropriate actions before harm is demonstrated (Oceans Act, DFO, 1997). This requires implementing adaptive management programs, wherein the development of resources is allowed to proceed only when there is an initial effort to assess impacts and a continuous commitment to monitor the activity and to adjust management accordingly (Lien, 2001).

Prior to this study, there was no record of research on the impact of whale-watching activities in Newfoundland and Labrador, and there were no specific regulatory measures in place. The objectives of this study, therefore, were to evaluate the effects of tour boat activity on whales and to test the feasibility of a newly introduced voluntary Code of Conduct as a management strategy for this province.

In order to assess environmental impacts effectively, studies must focus on the most susceptible areas and the most susceptible organisms - or *keystone species* (Mills *et al.*, 1993). These species are commonly used as sentinels for environmental quality, and it is assumed that taking measures to protect them may also benefit other species inhabiting the same location and animals in other locations subjected to less human impact.

Witless Bay was selected as the main study area because it is the island's most popular whale-watching locale. It is an important feeding ground for cetaceans and has been designated as a provincial Ecological Reserve. Humpback whales are the main targets of whale watching, while fin and minke whales are secondary targets.

Research Platforms

Behavioural sampling was conducted from land (2000), aboard tour boats (2002), and from an independent vessel (2003). Each of these methodologies allowed for the exploration of particular aspects of the boat-whale interaction and each also presented different advantages and disadvantages.

Land-based research has the advantage that observers are unlikely to have any effect on the observed animals. It also provides a broad perspective of the observed area and allows for control observations of undisturbed whale behaviour in the absence of tour boats (Bejder and Samuels, 2003). The main disadvantages are the restricted view of the animals, the fact that only the most conspicuous behaviour can be recorded, and the difficulty of focal animal sampling with small cetaceans or those that live in large pods.

Studies that used this methodology have been performed on harbour porpoises (Culik *et al.*, 2001), Hectors's dolphins (Bejder *et al.*, 1999), killer whales (Williams *et al.*, 2002a), fin whales (Stone *et al.*, 1992), and humpback whales (Baker and Herman, 1989).

Sampling from tour boat vessels has the advantage that researchers can complete a more refined analysis of whale behaviour as animals are in better view, and single individuals can be positively and repeatedly identified. This method also guarantees quick and relatively inexpensive access to the animals. However, use of this platform does present some limitations (Bejder and Samuels, 2003). First, only animals that are reasonably comfortable in proximity to boats can be studied, as the most sensitive may avoid such interactions or leave the area immediately. Second, a control is not available as the study can only be performed in the presence of the vessel. Third, researchers are rarely in control of tour boat manoeuvring and cannot decide which animal to study. Fourth, observation times are subject to trip schedules. Some studies that utilised this method have been performed on bottlenose dolphins (Constantine, 2001) dwarf minke whales (Birtles *et al.*, 2002), and humpback whales (Felix, 2001).

Behavioural studies from an independent research boat have the advantage of allowing researchers to follow specific individuals, to confirm the identity of animals in real time, and to determine the length of the observations. In addition, this method permits before, during and after impact assessments (Bejder and Samuels, 2003). This methodology has the disadvantage of introducing an external source of disturbance from the research vessel itself. This can be minimised by operating the vessel at a low speed, maintaining a buffer distance from the animals, reducing the number of course changes, and limiting noise emissions. Studies that have included this methodology have been performed on bottlenose dolphins (Allen and Read, 2000) and humpback whales (Corkeron, 1995; Miller *et al*., 2000).

Tagging

In the last few years tagging methodologies for cetaceans have been developed in order to better understand the behavioural ecology of whales in their natural habitat. These include satellite tags (Watkins *et al*., 1999), sonar tags (Watkins *et al*., 1993; Winn *et al*., 1995) and VHF tags (Goodyear, 1993; Winn *et al*., 1995; Malcolm and Duffus, 2000; Zimmer *et al*., 2003; Johnson and Tyack, 2003).

'Standard tags', commonly defined as TDRs, (time depth recorders), collect information on the number and depth of dives. Additional data regarding speed of whale, whale inclination, surfacing events, absolute position of whale (in case of satellite tags), water temperature and conductivity can be gathered by more sophisticated tags (Hanson and Baird, 1994). It is also possible to record ambient noise and whale vocalisations with digital acoustic recording tags (Johnson and Tyack, 2003). Individuals do not need to be followed by a boat at a close distance and behaviour can be recorded at night or in poor weather. Depending on tag type, data can be collected either through satellite, radio receivers, sonar scans or after retrieval of the tag following detachment.

Tags can be attached either through long-term implants or temporary attachment. Studies have found penetration tags to be rather invasive, at times inciting violent behaviour as in the case of some species of dolphins (Stone *et al.*, 1994). Temporary attachments may reduce some of these counterproductive effects because there is no need for penetration of barbs, rods or the use of glue (Stone *et al.*, 1994). Temporary tags have been successfully used on many cetaceans, but have not been utilised in studies on the impact of whale watching (Hanson and Baird, 1994; Malcolm and Duffus, 2000; Baird *et al.*, 2000; 2004). Using such a tagging methodology could provide important insights on whale diving behaviour during approaches of whale-watching boats.

While suction-cup tags are usually considered a non-invasive technique, some reports suggest they may also elicit a behavioural response in at least certain species of whales, a response usually comparable to that of whales darted during biopsy attempts (Goodyear, 1993; Hanson and Baird, 1994; Schneider *et al.*, 1998). Data on humpback whale reactions to tagging were collected in only one study, revealing a moderate response (Baird *et al.*, 2000; classification based on criteria developed by Weinrich *et al.*, 1992a). Due to this lack of data it was felt necessary to further investigate the impact of suction-cup tagging; for ethical reasons, studies that have an impact on target species should only be conducted if the benefits of performing them outweigh the cost to the animals. In addition, no data were available on reactions to tagging for whales in Newfoundland and Labrador and it is possible that certain populations (or portions of a population) may react differently depending on location and/or time of the year. Finally, it was important to assess whether an earlier disturbance from tagging could have interfered with a subsequent study of the impact of commercial whale-watching activities on the same whales.

Measures of disturbance

The main research objectives were to evaluate the impact of whale-watching vessel approaches on whale behaviour and to test the effectiveness of the Code of Conduct in minimizing potential effects. As part of this process, I also collected data on the effects of tagging on humpback whales, and gathered information on the diving profiles of whales in the Witless Bay area.

Following from previous studies of anthropogenic impacts on cetaceans in other locations (as reviewed by Bejder and Samuels, 2003), the five types of whale behavioural reactions recorded in the present research were: 1) immediate responses (measure of annoyance/perceived threat); 2) changes in swimming speed or direction (measure of horizontal avoidance); 3) changes in dive depths, profile or duration (measure of vertical avoidance); 4) changes in breathing rates; 5) changes in behavioural rates.

Experimental testing included comparisons of whale behaviour during the presence or absence of vessels, during approaches by different numbers of vessels, when tour boats either followed or violated the rules of the Code of Conduct, and when there were multiple infractions to the code.

6.2 Materials and Methods

6.2.1 Land-based study (2000)

In 2000, a viewing platform on a 10 m-high cliff at Ragged Point, Witless Bay was established (47° 15.905' N; 52° 48.786' W) (see map, Appendix A). A construction scaffold built on the cliffs raised observers an additional 3 m in height. From this position there was an unobstructed view of the Witless Bay area from South Head (47° 17.263' N; 52° 46.021' W) to Green Island (47° 14.360' N; 52° 47.028' W), allowing for the recording of tour boat and humpback whale activities in this area.

Whales were initially spotted with binoculars (7 x 50), a zoom camera with a 300 mm lens, a digital theodolite and by naked eye. Exact positions of whales and boats were not recorded. Four companies were included in this study (five larger boats, two of which were identical).

Data were recorded during the month of August whenever weather and sea conditions permitted (total = 10 days). Observation periods occurred between 8:00 to 18:00. The length of observation periods on any day varied due to water and visibility conditions from between 2 to 8 h. Conditions suitable for observation included a sea state less than 3 (Beaufort scale) and visibility greater than 5 km. Data collection was by 'focal animal sampling' and 'continuous recording' (Mann, 1999). A total of 1145 behavioural events were recorded during 92 observational sequences ('focal follows') (total time 8.2 h). Data were recorded on tape and later transcribed.

In selecting focal animals, observers favoured whales swimming alone and those closer to the observational station. We could not, however, always be certain when re-identifying animals at each surfacing, especially in cases in which several animals were present in the general area or after a whale took a long dive. For this reason, in analysing the data, I opted for pooling all behavioural events (from individuals in the field) into the following general categories: zero, 1, 2, or 3 vessels performing a '*whale watch*' on the focal animal (see definition of 'whale watch' in Chapter 4). I assume that any potential problems of over-representing the behaviour of particular individuals due to this data pooling would be counteracted by the fact that the same specimen may have been included in more than one category at different times. Results will have to be interpreted with these limitations in mind. Behaviour of the animals was classified according to Table 6.1. Breaching, spy hopping, lobtailing, tail slashing and flippering collectively are defined as aerial behaviour.

Table 6.1: Humpback whale behaviour recorded in Witless Bay, (based on Corkeron, 1995; Heyning, 1995; Gauthier and Sears 1999) (*only in 2002 and 2003).

BEHAVIOUR		DESCRIPTION
FLUKE UP		Whale arches its back in a diving posture bringing its flukes above the surface
FLUKE DOWN		Whale arches its back in a diving posture without bringing its flukes above the surface
SUBMERGING		Whale slowly submerges parallel to the water surface without arching its back
BLOWING		Whale emerges and blows producing a bushy shaped blow
TRUMPET BLOWING*		Whale emerges and forcefully blows emitting a characteristic high pitch sound
AERIAL	BREACHING	Whale emerges sideways from the water and lands on its back, producing a large splash
	SPY HOPPING	Whale emerges from the water head first holding this position for a short period of time
	LOBTAILING	Whale raises its flukes and slaps the water's surface in up-down fashion
	TAIL SLASHING*	Whale forcefully slashes the tail sideways
	FLIPPERING	Whale, in a belly-up position, slaps the water's surface with its flippers

6.2.2 Tour boat-based study (2002)

A behavioural study conducted from aboard tour boats took place in July and August 2002. The study was carried out on any day when conditions were suitable for observation (again, a sea-state less than 3 in the Beaufort scale and visibility superior to 5 km; 27 days in total). Five boats (two identical, owned by the same company) from four tour boat operations were used as research platforms. Data were gathered during 32 trips, for a total of 15.05 h of whale behavioural recording (28 ± 10 min per trip).

When the boat was in the vicinity of whales, the captain was asked to identify a focal animal and to begin a 'whale watch'. While flukes and fin characteristics were typically used as distinguishing features, identifying individuals by the dorsal fin had the advantage that animals could be recognised without having to wait for the terminal dive. Whales were photographed at the beginning, during, and at the end of the interaction with the tour boat for individual photo-identification (Katona *et al.*, 1979). This procedure is unlikely to have created any bias, as it is, in fact, standard procedure for captains to select an animal to follow during a particular whale watch (which they sometime announce to the passengers).

During the interaction, the distance between the boat and the whale was measured with the use of range finder binoculars (Bushnell, Yardage pro 1000). In optimum conditions, the range of the binoculars can measure targets up to 1 km. When conditions are poor (bad weather; moving, small or dark targets) sensitivity decreases. Before the study, trials were done to test the operative range of the binoculars. The best moment to get a fix was the preparation for the terminal dive when whales raised their tail or conspicuously arched their back. The furthest fix obtained for a humpback whale was at 327 m.

A digital video camera (SONY, DCR-TRV16) was used to film the interaction. Behavioural events, boat-whale distances and additional notes were also recorded on the audio track of the video camera with the use of a microphone. The on-board instrumentation was used to record boat position (GPS), speed, engine RPM and headings. Boat parameters were noted every minute, or more often if there was an obvious change in heading or speed. Behavioural events recorded were the same as in the year 2000 (Table 6.1). Performing the study from the whale-watching vessel, however, allowed for additional behavioural recording at a finer scale. In this study, for example, the researchers could easily distinguish between regular blows and trumpet blows (when a whale emerges and forcefully blows emitting a characteristic high pitch sound) and between lobtailing and tail slashing (when the whale forcefully slashes the tail in a sideway direction).

The experimental design included testing the effects on whale behaviour of violating the Code of Conduct and of the number of infractions per interaction. Breaches to the Code of Conduct were defined as in Chapter 4.

6.2.3 Independent vessel-based study (2003)

A behavioural study carried out from a research vessel took place in July and August 2003. This involved delivery of VHF-TDR tags onto whales, and later use of tour boats to perform approaches on the tagged animals. Short-term impacts of tagging on whale behaviour were evaluated, as were the subsequent effects of tour boat interactions.

Tags

Two identical VHF-TDR tags were utilised in the study (codes = MST-1 and MST-2). These were custom-built by H.A.B.I.T. Research, Victoria, BC, Canada. They weighed approximately 400 g each and consisted of a wooden, waterproof 'housing' containing sensors, logger, batteries and magnetic switches. A metal attachment connected the housing to a rubber suction cup (10 cm in diameter). Prior to deployment, silicon grease was applied to the suction cup in order to increase adhesiveness.

The tag detachment system consisted of a magnesium cap that gradually dissolved upon contact with salt water and broke the vacuum sealing at pre-set hours (4, 8 or 12 h; the selection of the cap was based upon remaining daylight hours). The tags had a VHF radio transmitter with a semi-rigid antenna (30 cm). The frequencies were set at 170.450 MHz (MST-1) and 171.450 MHz (MST-2). In order to save battery life, tags were equipped with a salt-water switch that turned off the radio signal once tags were completely submerged. The receiver was an R-1000 Telemetry Receiver

(Communication Specialist Inc., California). A 3-element antenna (Yagi) was used to increase the receiving range. Tags floated upon detachment and transmitted a radio signal for retrieval. The bright red colour also allowed visual retrieval.

Tags recorded depth, speed, water conductivity and temperature at 1 sec intervals. An optical connection allowed for data to be downloaded from the tag logger to a computer after retrieval. Data were downloaded and stored in MS Excel files.

Tag speed calibration

The speed sensor on the tags consisted of a flap that was depressed by water flowing through a conveyer tube (inclinometer). The faster the speed of the water the more the flap was depressed. Calibration was done prior to deployment at the tow tank facilities of the Department of Engineering, Memorial University of Newfoundland. Tags were mounted on an aluminium pole that was then attached to a carriage by clamps. Position of the tags was such that the sensors were located in front of the carrying pole in order to minimise the effect of the pole's turbulence. The tags were towed for 50 m at known velocities (0.25, 0.5, 1.0, 1.5, 2.0, 2.5, 3, 4, and 5 m/sec). During calibration, the tags were kept at a constant depth of 30 cm below the surface. For each tag a calibration curve was then calculated in order to convert inclination into speed values (MST-1, $y = -84.7x + 1836.5$; MST-2, $y = -152.27x + 1237.3$).

Tag deployment

Tags were deployed during the months of July and August 2003. A 7-m aluminium boat equipped with two 40-hp outboard 4-stroke engines was used for tagging and as an observational platform. The boat was equipped with a custom-made bow pulpit (1 m in length) in order to facilitate tag deployment. When available, a Zodiac equipped with a 20-hp outboard 2-stroke engine was also used for tagging. Eight tags were deployed from the aluminium boat and two from the Zodiac with a 5 m telescopic aluminium pool pole.

Tagging attempts were undertaken on 21 days, every day that weather, visibility (> 5 km) and sea conditions (< 3 on the Beaufort scale) allowed. Adult humpback whales not accompanied by calves were generally chosen for tagging. Other criteria for animal choice were: animals in pairs or in groups (seemed less wary of the vessel), animals engaged in searching or resting behaviour (easier to approach), animals not engaged in aerial behaviour (safety reasons), and animals with distinctive dorsal fins (easier to recognise). When suitable individuals were located, they were followed for a period of 30 min at a minimum distance of 100 m before any tagging attempts were made in order to collect pre-tagging behavioural data. It was also assumed that this time allowed for habituation to the research boat. Pictures of the flukes and of the fin were taken for individual identification. Range finders were used to determine whale distance.

After the pre-tagging period, the chosen animal was always approached parallel from behind, by the boat starboard side in order to reduce the risk of injury for the animal (only the port engine was used) and to avoid miscommunication between the pilot and the researcher performing the tagging in the presence of more animals. When whales were within reach of the pole an attempt to position the tag close to the dorsal fin was made. In case of a failure (i.e. tag was not deployed, tag dropped in the water or tag did not stick) attempts were aborted if the animal displayed a strong aversive reaction. Tagging attempts were also aborted after 45 min to limit disturbance caused to a single individual.

Tagging success

Out of 32 tagging attempts, 19 individuals were actually touched, and 10 whales were successfully tagged. This included eight adult humpback whales, one humpback calf and one fin whale. Table 6.2 reports the details of the 2003 tagging study.

There was no initial intention to conduct a study on cow-calf pairs or on fin whales, however field circumstances allowed easy tagging of both animals without pursuing them. The calf was tagged while actively interacting with the stationary research vessel (spy-hopping, rolling on its side, and logging at the surface close to the vessel). Although interpreting the meaning of this behaviour is difficult (e.g., play, curiosity, etc.), no visible reactions were noted after the tag was positioned and the calf continued the interaction. The mother was tagged subsequently as she approached the research boat.

The fin whale was tagged after it surfaced next to the research vessel while the vessel was stationary. The whale was seemingly resting right underneath the surface and it had been unnoticed prior to tagging. The whale submerged slightly after being touched by the tag but no other visible reaction was apparent.

Table 6.2: Details of the 2003 whale tagging study in Witless Bay (Notes: KF = aluminium boat; * calf; ** cow; KF* = after bow pulpit was installed; † assumed; ‡ two days later; NAHWC = North Atlantic Humpback Whale Catalogue).**

Whale ID	1	2	3	4	5	6	7	8	9	10
Species	Hump	Hump	Hump	Hump	Hump	Fin	Hump	Hump	Hump*	Hump**
NAHWC ID							#1673	#7138		
Date	18-Jul	24-Jul	27-Jul	28-Jul	30-Jul	1-Aug	2-Aug	4-Aug	7-Aug	7-Aug
Sea conditions	2	1	1	2	1	0	1	2	0	1
Wind direction		SW	SW	SW				NE	S	S
Weather	Sunny	Cloudy	Cloudy	Foggy	Sunny	Sunny	Sunny	Rainy	Cloudy	Cloudy
Tag #	MST-1	MST-1	MST-2	MST-1	MST-2	MST-1	MST-1	MST-2	MST-2	MST-1
Boat	KF	Zodiac	KF***	Zodiac	KF***	KF***	KF***	KF***	KF***	KF***
Tagging location min (47N; 52W)	15.852 47.104	16.719 46.710	18.137 44.677	16.770 47.246	15.681 47.682	16.165 47.110	16.426 47.152	15.720 47.518	22.170 49.922	22.013 42.204
Tagging time	12:25	9:22	14:47	11:58	12:29	11:27	11:12	13:29	12:58	14:47
Tag placement on whale body	Left, below fin	Right, below fin	Left, rear of fin	Right, almost on fin	Right, below fin	Left, visible arching	Left, below fin	Left, ahead of fin	Right, Visible Arching	Left, visible arching
Release Location min (47N; 52W)	15.574 47.096	Not Known	18.122 44.564	Not Known	16.185 47.035	21.271 43.065	16.636 46.981	15.992 47.399	21.202 42.965	21.202 42.965†
Time of release	12:36	10:10	17:19	12:50	15:06	17:39	11:20	14:43	16:52	16:30†
Total time on whale (min)	11	48	152	52	157	372	8	74	234	103
# of dives recorded	3	16	34	-	30	15	3	15	50	-
Retrieval location min (47N; 52W)		12.510 47.973		16.805 47.516	18.424 45.019‡					
Reaction to tagging	Strong	Moder -ate	Moder -ate	Low	Moder- ate	No reaction	Low	Low	No reaction	Strong
Impact study	No	No	Yes	No	Yes	No	No	Yes	No	No

Six animals were successfully tagged with MST-1 and four with MST-2. An effort to alternate the use of the two tags was made in order to reduce wear and tear. The tags' VHF radio system proved faulty, however, and after a few deliveries the tags stopped sending radio signals once submerged in salt water. Most likely this was due to a malfunction in the salt-water switch. Because of time restrictions with the field season, tagging attempts were continued and retrievals were done visually. MST-1 was lost after Whale 10 started a bout of aerial behaviour. MST-2 was lost at sea during an unsuccessful tagging attempt.

Tags were retained for a total of 20.2 h. The shortest attachment was 8 min. This may have been due to bad positioning on the whale, poor suction, or possible problems with the release system. The fin whale retained the tag for the longest time (6.2 h). For humpback whales, the calf retained the tag for the longest time (3.9 h). For the adult humpbacks the maximum retention time was 2.6 h (average 1.3 ± 0.9 h). A total of 1056 minutes of data were successfully retrieved from 8 tagged whales. For the other two whales, failure to retrieve data was due to erroneous tag programming (Whale 4) and to the loss of tag at sea (Whale 10). Six adult humpback whales had sufficient tag data to evaluate the impact of tagging on the diving profile, based on analysis of the first three dives subsequent to tagging.

Two whales included in the study had been previously photographed and included in the NAHWC (Rosemary Seton, Allied Whale, College of the Atlantic, Bar Harbour, Maine, U.S.). Individual 7 (NAHWC# 1673) had been sighted on July 17th, 1979, east of Baccalieu, Newfoundland, making the whale at least 24 years old at the time of the present study. Its gender was unknown. Individual 8 (NAHWC# 7130) had been sighted on July 15th, 1994 in the Old Fort Bay region in the Gulf of St. Lawrence by the Mingan Island Cetacean Study (MICS), and so was at least 10 years old at the time of this study. Its gender was unknown. No age or sex information was available for other individuals included in the study except for individual 9 (calf, estimated 6 - 7 months of age) and individual 10 (a female).

Surface data collection

A digital video camera (SONY, DCR-TRV16) was used to film tagging attempts and to record whale behaviour. Behaviour was also noted in a hand held computer (Palm Pilot) equipped with data collection software (Spectator Go, Bioserve, Germany) able to record time, behavioural event and status simultaneously. Data were then downloaded onto a personal computer and stored in MS Excel files. Behavioural events were recorded according to the 2002 study.

Experimental design to test the effect of whale-watching boats

In order to determine the effects of the interaction of the tour boats and of compliance with the Code of Conduct on whale behaviour the experimental design included pre-, during- and post-interaction phases. Forty-five minutes was the time assigned for each phase, but uncontrollable factors such as sea state, atmospheric conditions, time of day, whale behaviour, length of tag attachment and other unpredictable factors came into play. Total time of behavioural observations was 21.5 h (8.1 h of pre-interaction data, 5.5 h interaction, and 7.9 h post-interaction). Details are reported in Table 6.3.

Table 6.3: Experimental design for 2003 humpback whale behavioural study (n = 9).

PHASE (Ave. ± SD)	DESCRIPTION
Pre-interaction (54.3 ± 28.5 min)	This phase started immediately after a whale had been tagged; research vessels maintained at least 100 m distance; whale-watching vessels in the vicinity were radioed and discouraged from approaching the tagged animal (> 300 m); these data were used as controls.
Interaction (35.9 ± 17.6 min)	A tour boat in the vicinity was radioed and asked to perform a whale-watching interaction with the whale carrying the tag; interaction started when tour boat-whale distance < 300 m; research vessel maintained at least 100 m distance; other whale-watching vessels in the vicinity were radioed and discouraged from approaching the tagged animal (> 300 m); these data were used to test the effect of the tour boat approach.
Post-interaction (52.8 ± 22.7 min)	This phase started after the tour boat had completed the interaction with the tagged animal (> 300 m); research vessels maintained at least 100 m distance; other whale-watching vessels in the vicinity were radioed and discouraged from approaching the tagged animal (> 300 m); these data were used to investigate recovery time.

Four vessels (two sister boats) from three whale-watching companies were recruited to perform their 'regular' whale watch on the experimental animal (two interactions per vessel, one vessel performed three). During each phase, research vessel manoeuvring was always kept minimal in order to reduce noise emissions. Research vessel-whale distance was always kept to more than 100 m, unless the whale suddenly approached the vessel (the average distance during the study was 183 ± 111 m); this was done to minimise the possible confounding effect of the presence of the research vessel (in agreement with Corkeron, 1995; and Williams *et al.*, 2002). Compliance or violation of the code was established according to the methods provided in Chapter 4.

Three adult humpback whales (ID #3, #5 and #8) retained the VHF tags long enough to allow a complete recording of whale diving behaviour in the pre-, during and post-interaction phases with whale-watching boats. An additional six humpback whales not carrying tags were included in this study. For these animals, the methodology was the same except that parameters could only be calculated from their surface behaviour. Data from the fin whale and from the humpback whale calf were not included in the impact study.

For every individual whale, behavioural parameters were calculated as averages for each phase. Due to low sampling numbers, only data collected at the surface could be used to evaluate any effects of the Code of Conduct.

6.2.4 Data analysis

Surface behaviour

Parameters used to analyse whale surface behaviour are presented in Table 6.4 (Dolphin, 1987b; 1988; Baker and Herman, 1989).

Table 6.4: Parameters used for humpback whale surface behavioural analysis (Dolphin, 1987b; 1988; Baker and Herman, 1989).

PARAMETER	DESCRIPTION
Number of blows per surfacing	Count data
Blow interval (sec)	Interval data
Blow rate (n/sec)	Number of blows/[(surface interval (sec) + subsequent diving time (sec)]
Fluke-up time (time from last blow to fluke-up) (sec)	Interval data
Ratio between surface time and diving time	Ratio
Frequency of shallow dives (dives with no fluke up)	Count data
Frequency of surface behavioural events	Count data

Surface behaviour (immediate responses)

Video footage was used to analyse whale behavioural reactions to tagging attempts. Whale reactions were classified according to Weinrich *et al.* (1992a) (Table 6.5). A total of 32 attempts (different individual humpback whales) were analysed. Nine of these were successful taggings, 10 involved some tag contact with whales' bodies, and 13 were close approaches by the boat (< 5 m), but with no tag contact.

Table 6.5: Classification of immediate humpback whale behavioural responses (Weinrich *et al.*, 1992a).

SCALE OF REACTION	DESCRIPTION
No reaction	No interruption of pre-tagging behaviour
Low	Slight change in behaviour (i.e. immediate dive often with a fluke down)
Moderate	More forceful change in behaviour (i.e. trumpet blows and tail slashes)
Strong	Forceful reaction of the animal which may be prolonged after the tagging event (i.e. multiple tail slashes and repeated trumpet blows)

Spatial parameters

The tag inclinometer did not prove to be a very reliable tool for measuring whale speed, and noise levels in the speed graphs obtained were very high. These difficulties, associated with the fact that tags were positioned in different locations on the whales' bodies (and possibly susceptible to different turbulence; Fish, 2002) made tag speed measurements very inaccurate and comparisons impossible. Therefore speed was only calculated from surface data.

To investigate if humpback whales adopted horizontal avoidance strategies to whale-watching vessels, spatial parameters considered were (according to Williams *et al.*, 2002a; Jahoda *et al.*, 2003):

- speed (m/sec) (average speed at the surface)
- index of linearity (ratio of the net distance between the initial and final tracking point over the total distance travelled)

Diving profiles

To investigate if humpback whales adopted vertical avoidance strategies to whale-watching vessels, I analysed diving profiles according to Dolphin (1987a; 1987b; 1988) and Baird *et al.* (2002). Classification of dives in cetaceans can be problematic (Hooker and Baird, 2001). In this thesis, when depth data were not available, I defined a dive as any interval between a fluke up (or down) and the subsequent blow or any interval between two blows that lasted more than 1.5 min (Dolphin, 1987a; 1988). I categorized dives in which humpback whales did not show their flukes prior to submerging as shallow dives (Carwardine, 2000). In cases in which depth data were available, I defined a dive as an immersion deeper than 5 m. According to the results shown in Fig 6.3, I also discriminated dives as shallow (≤ 25 m) and deep (> 25 m). Due to the malfunctioning of the speed sensor, ascent and descent rates were calculated from the diving profiles. Parameters calculated are presented in Table 6.6

Table 6.6: Parameters utilised to analyse humpback whale diving profiles (Dolphin, 1987a, 1987b, 1988; Baird *et al.*, 2002).

PARAMETER	DESCRIPTION
Diving time (min)	Interval data
Maximum diving depth (m)	Interval data
Descent rate (m/sec)	Rate
Ascent rate (m/sec)	Rate
Time spent at depth (85% of maximum depth) (min)	Interval data
Time spent at depth with respect to total time	Percentage

Calculating whale-watching boat – whale distance

For this study, research was carried out from an independent vessel, therefore tour boat-whale distance had to be calculated using a trigonometric equation (Fig. 6.1).

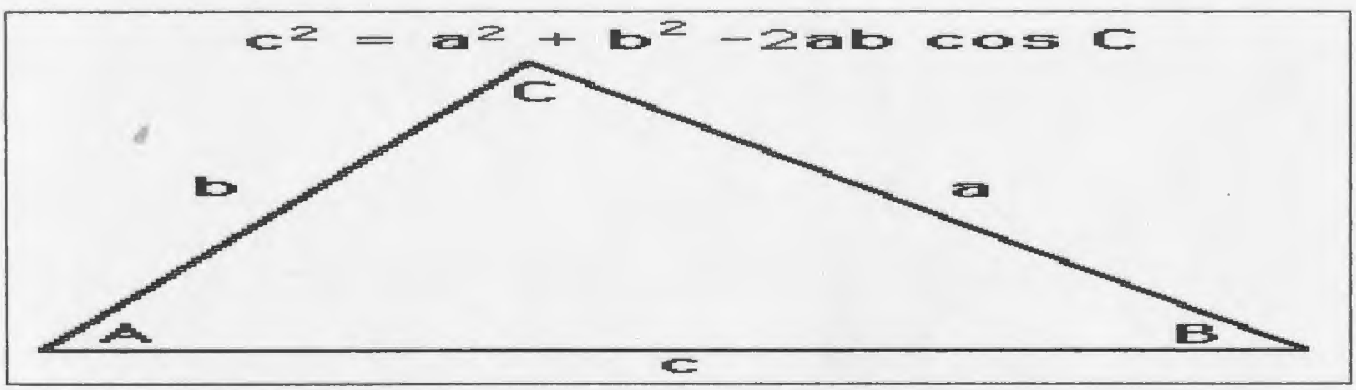

Fig. 6.1: Law of Cosines.

Assuming that the observing platform was located over angle C, the whale-watching boat over angle A and the whale over angle B, the distance c (tour boat–whale) could be simply calculated by applying the Law of Cosines ($c^2 = a^2 + b^2 - 2ab \cos C$). All it required was knowledge of the distance between the observing platform and the whale-watching boat (b), the distance between the observing platform and the whale (a) and the size of the angle C. The size of the angle C was measured with the aid of a compass. Land trials showed that when estimating the distance between two objects (106 m from each other) from an average distance of 243.9 ± 120.4 m, the average estimate obtained was 109.5 ± 14.7 m (n = 10), with an error of only 2.8% in terms of accuracy.

Statistical Analysis

For frequency data χ^2 tests (or Fisher exact test with low cell values), Cochran's Q tests (*k*-related samples), and Goodman and Kruskal's tau tests were used. The latter provides a directional measure of association, meaning the dependent variable is indicated (Goodman and Kruskal, 1979). Frequency data were presented in contingency tables (r x k, where r = categorical responses, k = independent groups). Counts and percentages were reported in tables along with the *standardized* residuals (i.e. the discrepancy between the observed and the expected values, divided by an estimate of the standard error). These were calculated to determine which cells in a table had counts larger than expected by chance, as described by Siegel and Castellan (1988; 197 p.). According to this method, standardized residuals higher than 1.96, can be considered significant at the α = 0.05 level (two-tailed) and higher than 2.58 at the α = 0.01 level (two-tailed).

For interval data, and according to data distribution, parametric ANOVA and non-parametric Friedman test (multiple repeated samples), and Wilcoxon signed rank test (paired replicates) were used to investigate differences in population distributions. GLM (Univariate and Repeated Measures) were used to investigate the contributions of multiple independent variables on the variance of a dependent variable. Least Significant Difference (LSD), and HSD Tukey's post-hoc tests were used to investigate significant differences within experimental variables following a significant ANOVA (Lomax, 2001). For non-parametric multiple comparisons, the procedure described by Siegel and Castellan (1988; 180 p.) was used.

Spearman's coefficient rho was calculated to investigate correlations between variables. The statistical package used for data analysis was SPSS 12.0.1 (SPSS Inc., 1989-2004). The level of confidence assumed was 95%. Means and standard deviations were usually used as descriptive statistics, but medians (25 – 75, percentiles) were used for the diving data (impact of tagging), because dives showed a bimodal distribution.

6.3 Results

6.3.1 Effects of tagging on humpback whale behaviour

Immediate behavioural response

Of the 19 events where the tag made contact with the animals' body, two of the whales had no reaction, four had a low reaction, eight had a moderate reaction and five had a strong reaction. The mother displayed a strong reaction while the calf had no visible reaction. Immediate dives were observed in all cases except responses in the 'no reaction' category. Moderate reactions included tail slashing above or below the surface. Strong reactions included slashing the tail toward the boat, repetitive trumpet blows and changes in swimming direction. Table 6.7 presents a comparison of the results of the present study with studies of other authors that investigated humpback whale reactions to a similar procedure (biopsy attempts) (Weinrich *et al.*, 1992a; Clapham and Mattila, 1993, Brown *et al.*, 1994).

The present study found a higher percentage of strong reactions (26.4%) than all the others (≤ 5.6%) [$\chi^2(9, n = 858) = 191.77$, $p < 0.01$; standardised residual = 10.2, $p < 0.01$]. The analysis included a 2 x 2 cross tabulation to compare the results of the present study with those of Weinrich *et al.*, (1992a), which reported the second highest percentage of strong reactions [$\chi^2(1, n = 90) = 7.12$, $p < 0.01$].

Table 6.7: Responses of humpback whales to tagging in 2003, compared with other studies (all categories based on Weinrich *et al.*, 1992a).

STUDY		No reaction	Low reaction	Moderate reaction	Strong reaction	N
Weinrich *et al.* (1992a)	Count	5	19	43	4	71
	Percentage	7.0%	26.8%	60.6%	5.6%	
	Std. residual	-4.7	0.6	4.2	3.5	
Clapham and Mattila (1993)	Count	249	127	188	1	565
	Percentage	44.1%	22.5%	33.22%	0.18%	
	Std. residual	0.1	-0.3	0.5	-2.2	
Brown *et al.* (1994)	Count	119	48	36	0	203
	Percentage	58.6%	23.6%	17.8%	0%	
	Std. residual	3.2	0.2	-3.6	-1.5	
This study (2003)	Count	2	4	8	5	19
	Percentage	10.5%	21.0%	42.1%	***26.4%***	
	Std. residual	-2.2	-0.2	0.8	***10.2***	
Total	Count	375	198	275	10	858

Table 6.8 reports the types of reactions of humpback whales to tagging attempts divided by tagging outcome (whale was tagged; whale was touched but tag did not attach; tag missed the whale). Total number was 32. Tagging outcome did not influence the level of whale reactions [$\chi^2(6, n = 32) = 3.27, p = 0.77$].

Table 6.8: Comparison of immediate humpback whale reactions in relation to tagging outcome during the 2003 study.

OUTCOME		No reaction	Low reaction	Moderate reaction	Strong reaction	N
Tag was attached	Count	1	3	3	2	9
	Percentage	11%	33%	33%	23%	
Tag touched but did not attach	Count	1	1	5	3	10
	Percentage	10%	10%	50%	30%	
Tag missed	Count	3	4	4	2	13
	Percentage	23%	31%	31%	15%	
Total		5	8	12	7	32

Diving profiles

Fig. 6.2 displays an example of a humpback whale diving profile following a tagging event. Tagging, which occurred at 12:29:41, was immediately followed by a shallow dive (tagging dive). This dive was 11.2 m deep and lasted for 0.5 min.

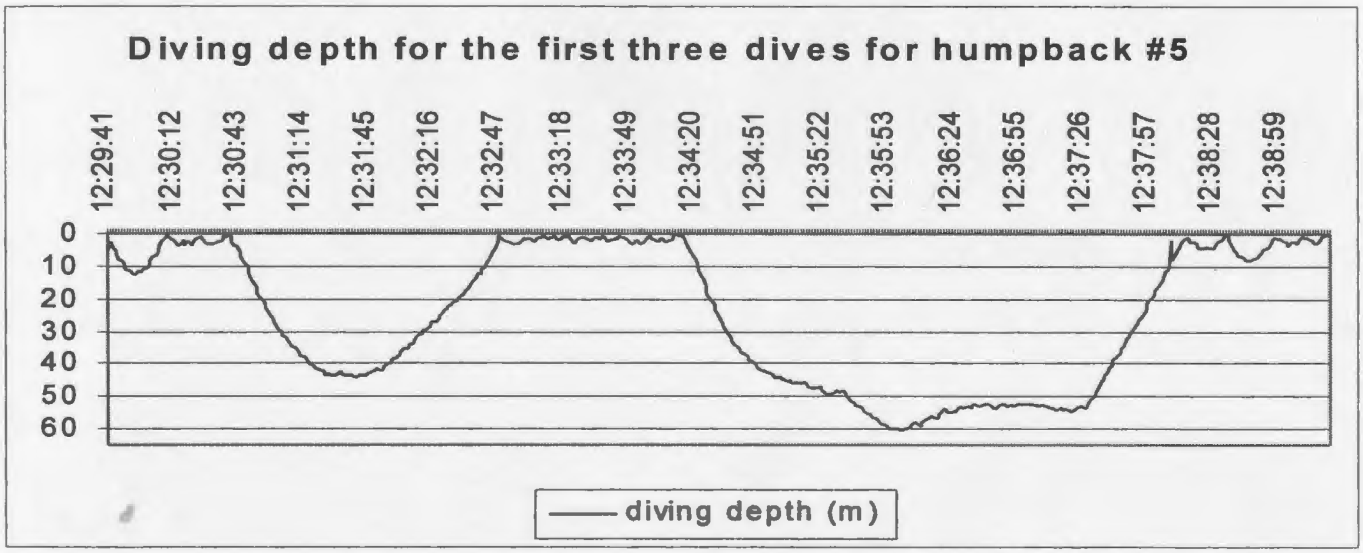

Fig. 6.2: Example of diving profile (first 3 dives) of a humpback whale (Whale ID #5, 2003 study) after the delivery of a VHF-TDR tag. (Water depth was 65 m. This whale had shown a moderate immediate behavioural response to tagging).

The whale resurfaced at 12:30:12, blew 3 times (one was a trumpet blow) and dove again at 12:30:43, raising its flukes above water. The time spent at the surface was 0.5 min. The maximum depth of this second dive was 43.5 m. This was a round-bottom dive that lasted for 2.1 min. At 12:32:47 the whale resurfaced. The second period at the surface lasted for 1.4 min, during which the whale blew 5 times (no trumpet blows). At 12:33:20 the whale lingered with the tail sticking out of the water in a vertical position. The whale dove again with a fluke up at 12:34:20. This dive lasted for 4.0 min with a maximum depth of 60.2 m. The shape of this dive was more irregular with respect to the previous two dives and presented few changes in depth.

Diving profiles were available for 6 humpback whales. Two of these whales showed a low immediate behavioural reaction to tagging, 3 a moderate reaction and 1 a strong reaction. In all 6 cases, whales immediately dove after the tagging event (tagging dives). In 5 cases these initial dives were shallow. For the tagging dive, the overall median maximum diving depth was 12.8 m (10.2 - 37.7). Median diving time was 0.9 min (0.6 – 1.4). Median descent rate was 0.72 m/sec (0.48 - 1.01), while median ascent rate was 0.58 m/sec (0.47 - 0.79). Median time at maximum depth was 0.4 min (0.3 - 0.5), which represented 46% (33 - 55) of total diving time. Only one whale performed a deep dive (maximum diving depth 83.6 m; diving time 2.5 min). This whale had shown a moderate immediate reaction to tagging.

In 4 cases humpback whales followed the shallow dive with a deeper and longer dive. For this second dive, the median maximum diving depth was 32.4 m (11.1 - 47.8), diving time was 1.9 min (1.0 - 2.4), descent rate was 0.76 m/sec (0.37 - 1.10) and ascent rate was 0.48 m/sec (0.23 - 1.16). Median time at maximum depth was 0.7 min (0.4 - 1.1), which represented 44% (37 - 53) of the total diving time.

Four out of six whales also showed a deep third dive. For this dive, the median maximum diving depth was 37.4 m (17.6 - 62.2), diving time was 2.5 min (1.4 - 3.3), descent rate was 0.54 m/sec (0.45 - 0.93), and ascent rate was 0.54 m/sec (0.38 - 1.23). Median time at maximum depth was 1.0 min, representing 38% (32 - 51) of diving time.

The median time between the tagging dive and the second dive was 0.6 min (0.2 - 2.0), the number of blows was 3 (2.5 - 6.0), and the blow interval was 16 sec (14.5 - 19.5). The median time between the second and the third dive was 1.6 min (1.3 - 2.0), the number of blows was 6 (5.0 - 7.5) and the blow interval was 19 sec (13.5 - 20.5).

Although diving parameters indicated a trend in whales performing a first shallow dive subsequent to tagging, only 'time at maximum depth' showed statistically significant differences among dives ($p = 0.04$; third dive longer than tagging, $p < 0.05$; Table 6.9).

Table 6.9: Diving and surface parameters of humpback whales during the three dives following a tagging event (2003 study). Statistics include Friedman test (χ^2), Wilcoxon Signed rank test (z) and Cochran Q-test (q).

PARAMETERS	TAGGING DIVE	SECOND DIVE	THIRD DIVE	Statistic	df	P value
N = 6	Median (25 - 75)	Median (25 - 75)	Median (25 – 75)			
Maximum depth of dive (m)	12.8 (10.2 - 37.7)	32.4 (11.1 - 47.8)	37.4 (17.6 – 62.2)	$\chi^2 = 3.00$	2	0.22
Diving time (min)	0.9 (0.6 – 1.4)	1.9 (1.0 – 2.4)	2.5 (1.4 – 3.3)	$\chi^2 = 4.33$	2	0.11
Descent rate (m/sec)	0.72 (0.48 – 1.01)	0.76 (0.37 – 1.10)	0.54 (0.45 – 0.93)	$\chi^2 = 1.00$	2	0.60
Ascent rate (m/sec)	0.58 (0.47 – 0.79)	0.48 (0.23 – 1.16)	0.54 (0.38 – 1.23)	$\chi^2 = 2.33$	2	0.31
Time at max depth (min)	***0.4* (0.3 – 0.5)***	***0.7 (0.4 – 1.1)***	***1.0* (0.5 – 1.4)***	$\chi^2 = 6.63$	***2***	***0.04***
	****multiple comparisons for the three dives: tagging dive ≠ third dive (p < 0.05)***					
Time at depth (%)	46 (33 - 55)	44 (37 – 53)	38 (32 – 51)	$\chi^2 = 1.00$	2	0.60
Time between each dive (min)	-	0.6 (0.2 – 2.0)	1.6 (1.3 – 2.0)	z = -1.57	-	0.12
Number of blows before dive	-	3 (2.5 – 6.0)	6 (5.0 – 7.5)	z = -1.22	-	0.22
Blow interval before dive (sec)	-	16 (14.5 – 19.5)	19 (13.5 – 20.5)	z = -0.38	-	0.70
Shallow dives (≤ 25 m)	n = 5	n = 2	n = 2	q = 3.60	2	0.16

6.3.2 Whales' diving profiles in Witless Bay

Adult humpback whales

In total, 95 dives were included in this analysis, recorded for 6 adult humpback whales (3 of these whales took part in the impact study, but as analysis showed no vertical reaction to tour boats, including them in this analysis seemed legitimate). The average number of dives per whale was 15.8 ± 13.1 (range 2 – 33, tagging dives excluded from this analysis). Diving depth showed a bimodal distribution, with a cut off point in the 26–30 m range (Fig. 6.3). Therefore, for the scope of analysis, I discriminated between shallow (≤ 25 m; n = 53; 56%) and deep dives (> 25 m; n = 42; 44%).

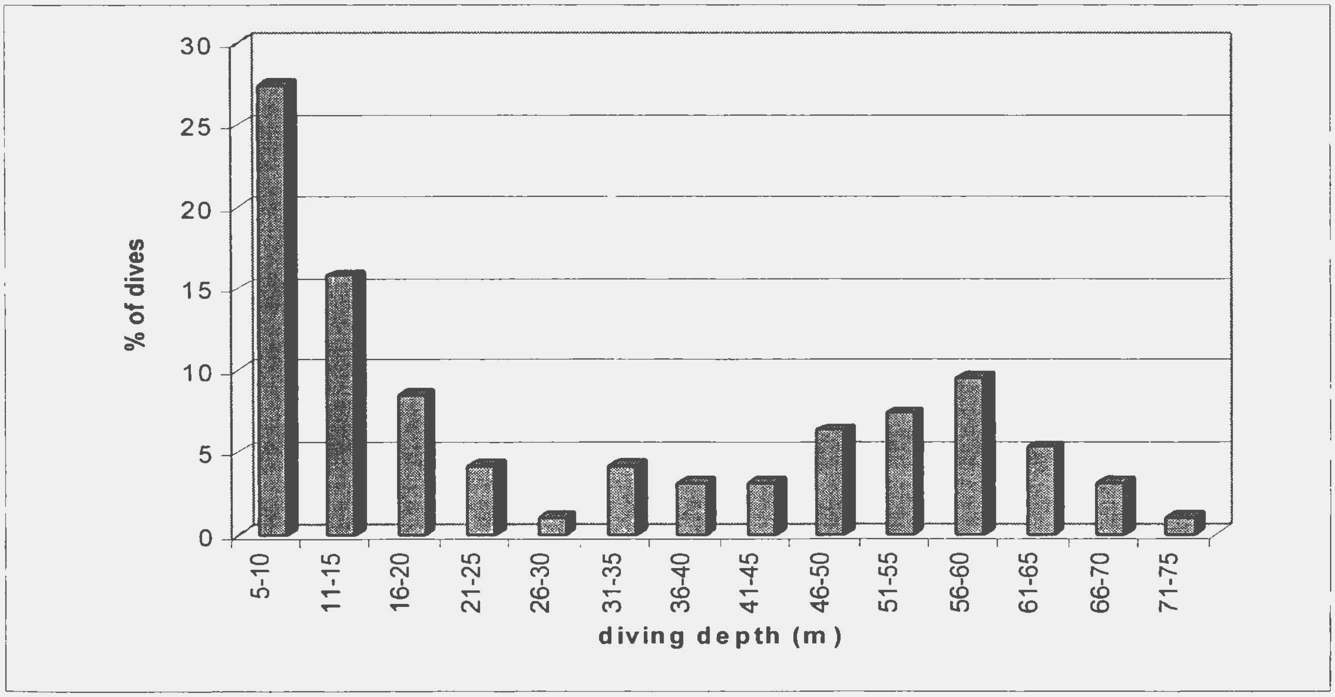

Fig. 6.3: Frequency distribution of adult humpback whale dives (study 2003, n = 95).

For shallow dives, the average diving depth was 11.8 ± 4.8 m, and the average diving time was 1.2 ± 0.3 min (water depth range was 40 – 90 m). The average descent rate was 0.37 ± 0.12 m/sec. The average ascent rate was 0.33 ± 0.11 m/sec. The average time at maximum depth was 0.6 ± 0.2 min. The average percentage of time-spent time at maximum depth was 51 ± 12%.

For deep dives, the average diving depth was 51.6 ± 11.0 m, and the average diving time was 3.2 ± 0.9 min (water depth average 63 ± 17 m, range 35 – 88 m). Nineteen per cent of the dives were to the ocean bottom, including the deepest dive (73 m). The longest dive was 5.3 min, during which the whale reached a depth of 48.1 m. The average descent rate was 0.89 ± 0.28 m/sec. The average ascent rate was 0.84 ± 0.34 m/sec. The fastest descent (1.69 m/sec) and ascent rates (1.61 m/sec) were reached by the same whale in the same dive; this dive was 1.6 min long and 34 m deep. The average time at maximum depth was 1.6 ± 0.8 min. The longest time spent at maximum depth (48.1 m) was 3.7 min and represented 70% of total diving time, the highest percentage for all adult humpback whales. The average percentage of time-spent time at maximum depth was 48 ± 13%.

For all dives, descent and ascent rates were positively correlated with diving depth (rho = 0.84, $p < 0.01$; rho = 0.81, $p < 0.01$). Diving time was also positively correlated with diving depth (rho = 0.90, $p < 0.01$) (Fig. 6.4). An example of a humpback whale diving profile is provided in Figure 6.5. This whale was feeding until 9:45 and then switched to a searching behavioural status (see Table 4.2, p.103 for definitions).

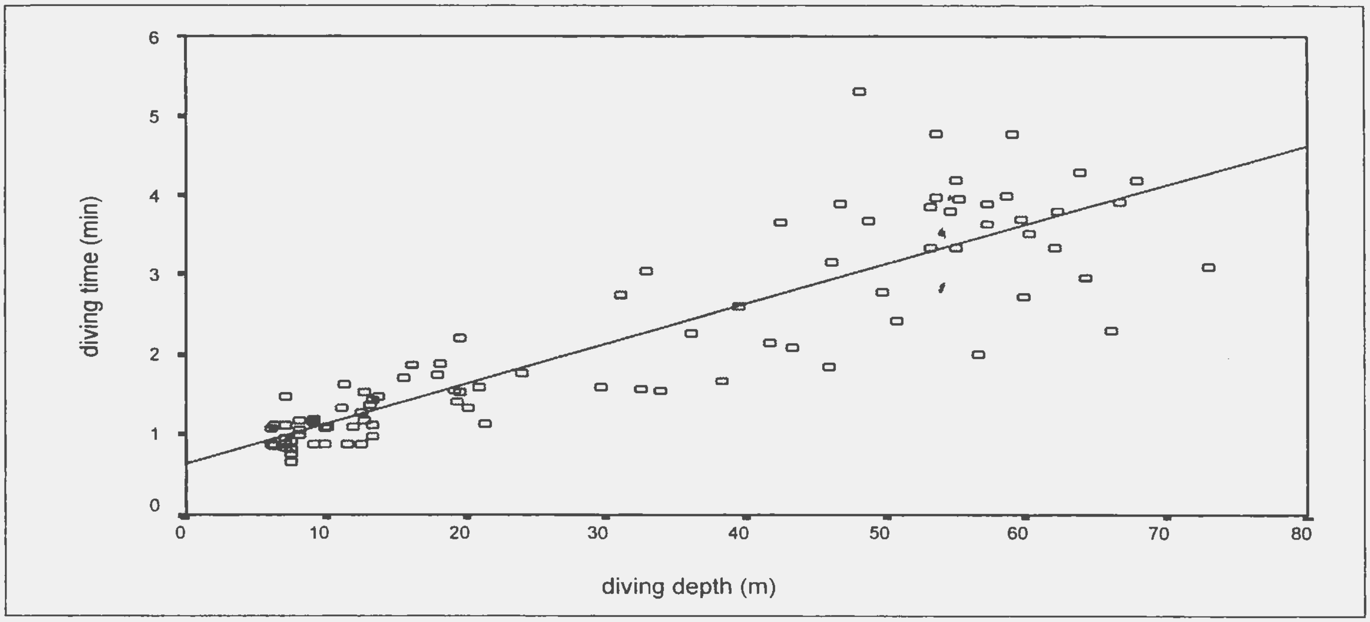

Fig. 6.4: Correlation between the diving time and the diving depth of humpback whales during the 2003 study (Spearman's rho = 0.90, p < 0.01) (n = 95).

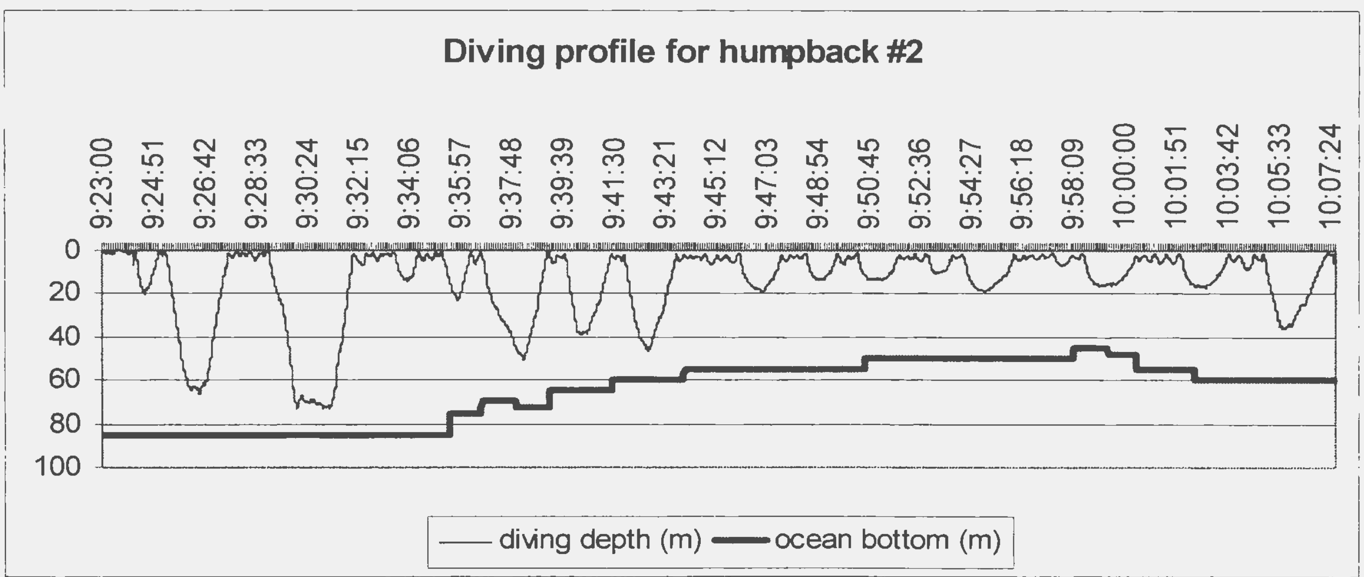

Fig. 6.5: Example of diving profile of an adult humpback whale (Whale ID #2, 2003 study) as recorded by the VHF-TDR tag.

Humpback whale calf

For the humpback whale calf, a total of 50 dives were recorded. Of these, 34 were shallow (≤ 25 m; 68%) and 16 were deep (> 25 m; 32%). The frequency distribution of dives for this animal is shown in Figure 6.6.

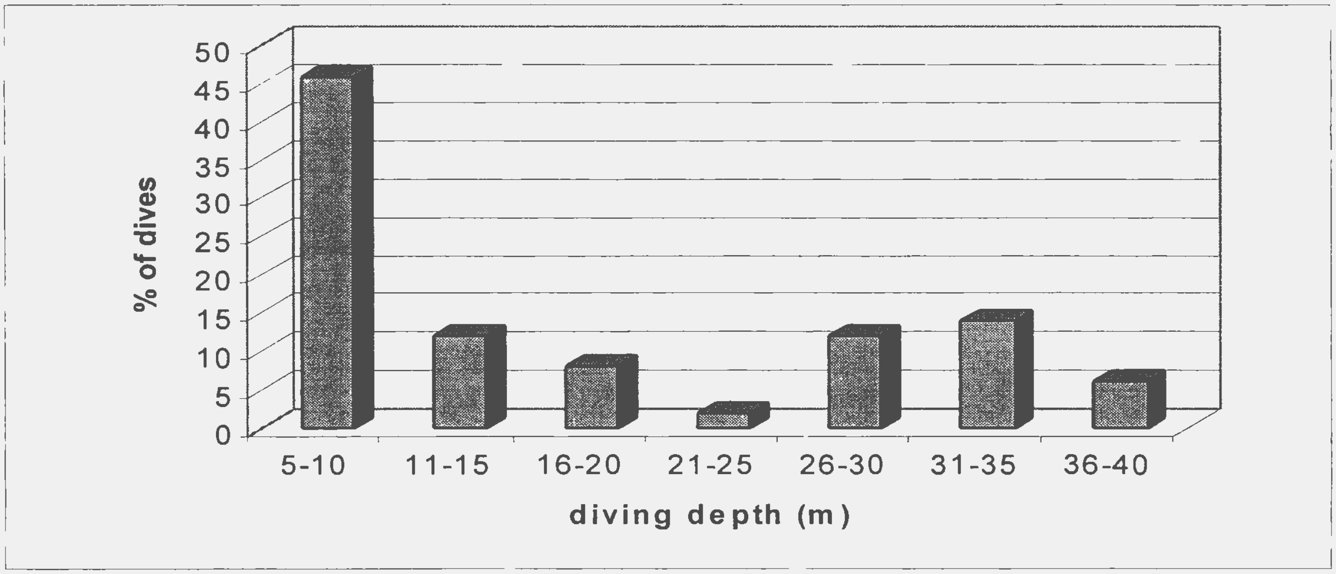

Fig. 6.6: Frequency distribution of dives of the humpback whale calf recorded during study 2003 (n = 50).

For shallow dives, the average diving depth was 9.9 ± 4.5 m and the average diving time was 1.3 ± 0.6 min. The average descent rate was 0.37 ± 0.16 m/sec and the average ascent rate was 0.33 ± 0.19. The average time at maximum depth was 0.9 ± 0.4 min. The average percentage of time spent at depth with respect to total time was 69 ± 13%.

For the deep dives, the average diving depth was 32.4 ± 3.5 m and the average diving time was 3.5 ± 0.9 min. The deepest dive was performed at 15:32 and was 40.6 m deep (water depth 70 m). The longest dive (at 14:32) was 4.9 min, during which the calf reached a depth of 31.5 m (water depth 39 m). For the deep dives, the average descent rate was 0.49 ± 0.21 m/sec (maximum 0.85 m/sec). The average ascent rate was 0.38 ± 0.21 (maximum 0.96 m/sec). The average time at maximum depth was 1.4 ± 0.5 min. The longest time spent at maximum depth (35.1 m) was 2.2 min. The average percentage of time spent at depth with respect to total time was 41 ± 11%. The diving profile of the humpback whale calf is shown in Figure 6.7. This whale was active at the surface until 14:30 (rolling, spy-hopping, etc.) and then started travelling at 14:30.

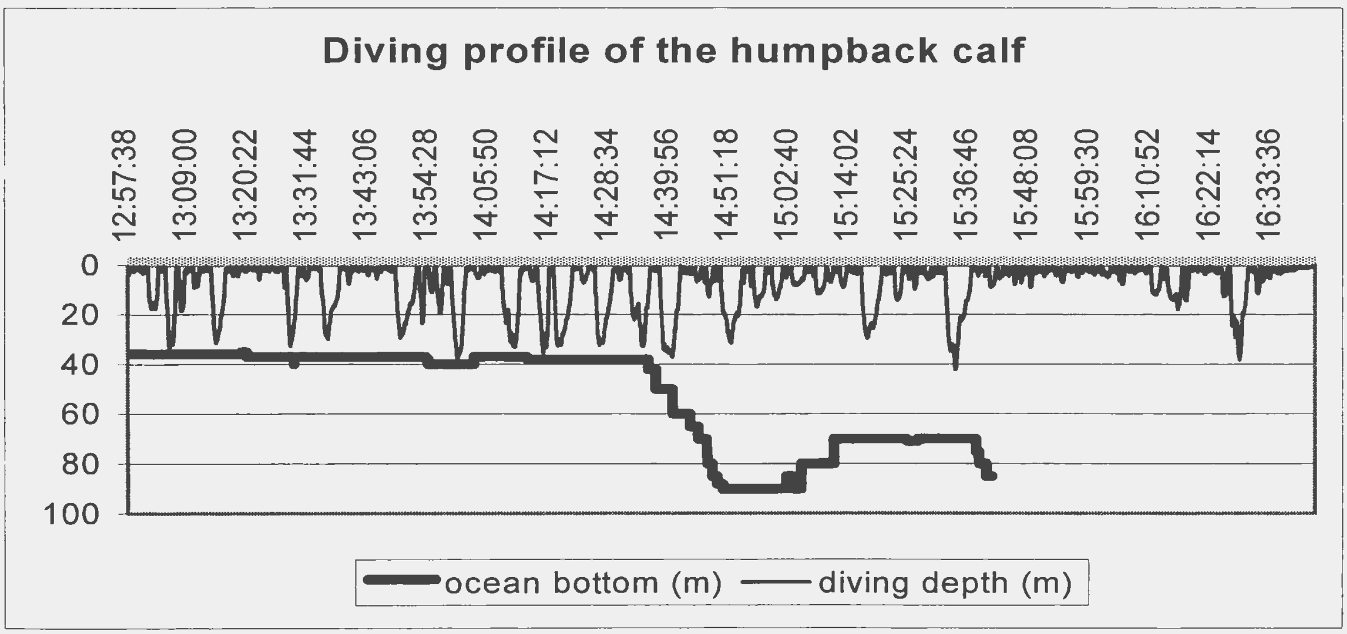

Fig. 6.7: Diving profile of the humpback whale calf tagged during the 2003 study (Ocean depth data incomplete due to loss of visual contact with the calf).

Fin whale

Fifteen dives were recorded for the fin whale, of which 4 were to the ocean floor, and one was less than 25 m (Fig 6.8). The overall average diving depth was 39.9 ± 14.3 m and diving time was 3.9 ± 0.9 min (water depth range was 37 - 87 m). The deepest dive (15:39) reached 63 m (water depth 68 m). The longest dive (11:30) was 5.2 min, during which the fin whale reached a depth of 48 m (water depth 70 m). The average descent rate was 0.51 ± 0.21 m/sec (maximum 1.01 m/sec). The average ascent rate was 0.35 ± 0.19 (maximum 0.75m/sec). The average time at maximum depth was 1.0 ± 0.5 min. The longest time spent at maximum depth (69.6 m) was 1.8 min. The average percentage of time spent at depth with respect to total time was 28 ± 12% (maximum 55%). The behaviour of this whale included resting below the surface (until 12:30), slow travelling within a limited area (12:30 – 15:00), and then linear travelling after that.

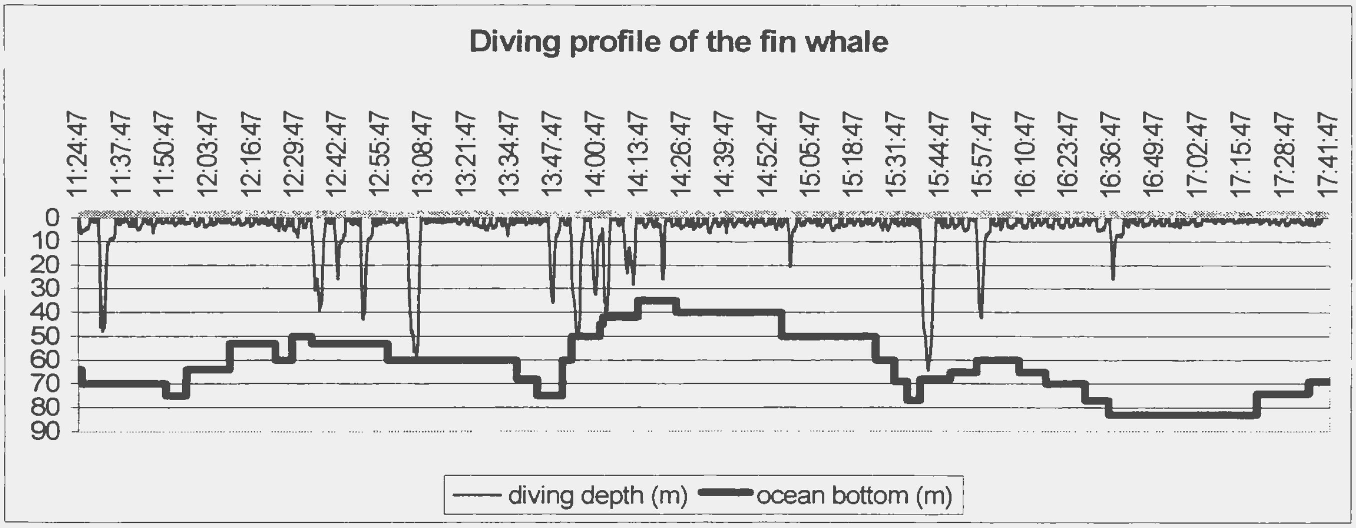

Fig. 6.8: Diving profile of the fin whale tagged during the 2003 study.

6.3.3 Effects of presence and number of tour boats on humpback whale behaviour

During the 2000 study at least one whale-watching vessel was engaged in a 'whale watch' with the focal whale 72% of the time observations were made. Specifically, whales were accompanied by one boat 39% of the time, by two boats 16% of the time, and by three boats 17% of the time.

The blow interval changed according to the number of whale-watching boats that approached whales (ANOVA, df = 3, F = 3.37, p = 0.01). When three boats approached the whales the animals showed the longest interval between blows (Tukey's HSD, $p < 0.05$). Results are shown in Table 6.10. Fluke up times did not vary by number of tour boats engaged in a 'whale watch' (ANOVA, df = 3, F = 0.85, p = 0.46; overall average 7.2 ± 3.5 sec, n = 239).

Table 6.10: Results of the post-hoc Tukey's HSD test for humpback whale blow interval during the 2000 behavioural study (results included in separate subsets are statistically different, $p < 0.05$).

NUMBER OF BOATS	BLOW INTERVAL		
	N	Average ± SD (sec)	
		Subset 1	Subset 2
0	165	17.7 ± 10.9	
1	243	17.7 ± 11.7	
2	92	17.8 ± 12.2	
3	84		22.1 ± 13.2
p value		1.00	1.00

The frequency of behaviour depended on the number of observing whale-watching boats (Goodman and Kruskal's tau = 0.27, $p < 0.01$, behaviour = dependent variable). In particular, when the number of tour boats increased (> 1), instances of aerial behaviour increased significantly (standardised residuals = 10.1 and 6.6, $p < 0.01$; Table 6.11). Instances of aerial behaviour were also statistically higher during approaches of one boat than during the absence of vessels (contingency table 2 x 3, no boats versus one boat, Goodman and Kruskal's tau = 0.15, $p < 0.01$, behaviour = dependent variable, standardised residual = 3.3, $p < 0.01$).

Table 6.11: Frequency of humpback whale behaviour by number of whale-watching boats performing a 'whale watch' during the 2000 study.

NUMBER OF BOATS		Blow	Fluke up	Aerial	N
No boats	Count	211	41	1	253
	Percentage	83.4%	16.21%	0.39%	
	Std. residual	***7.5***	***3.0***	- 9.9	
One boat	Count	283	59	46	388
	Percentage	72.9%	15.2%	11.9%	
	Std. residual	***6.4***	***3.2***	- 8.7	
Two boats	Count	107	21	307	435
	Percentage	24.6%	4.8%	70.6%	
	Std. residual	- 7.5	- 3.5	***10.1***	
Three boats	Count	101	21	206	328
	Percentage	30.8%	6.4%	62.8%	
	Std. residual	- 4.9	- 2.1	***6.6***	
Total	Count	702	142	560	1404

6.3.4 Effects of boat interactions and of code on humpback whale behaviour (pre, during, post-interaction study)

6.3.4.1 Vertical avoidance

Three adult humpback whales retained the VHF tags long enough to allow a complete recording of whale diving behaviour during the three experimental phases (the tagging dive was excluded from analysis). For the other six humpback whales, vertical avoidance was investigated from parameters calculated from their surface behaviour.

For the variables 'diving time' and 'ratio surface/diving time', it was possible to test both the effects of tour boat interaction and of compliance to the code. Descriptive statistics and the results of ANOVA (repeated measures) for variables calculated from tag data are reported in Table 6.12. (Data for the repeated measure analysis was submitted as average per each individual whale per each phase).

Table 6.12: Descriptive statistics and results of the repeated measure ANOVA for diving parameters of humpback whales recorded with the VHF-TDR tags (n = 3) during different experimental phases of the 2003 study.

VARIABLE	N	EXPERIMENTAL PHASES			ANOVA	p value
		Pre	During	Post		
		Ave ± SD	Ave ± SD	Ave ± SD		
Average depth (m)	3	26.0 ± 9.7	27.8 ± 15.9	32.6 ± 20.2	F = 0.98	0.45
Descent rate (m/sec)	3	0.61 ± 0.21	0.50 ± 0.71	0.60 ± 0.24	F = 1.14	0.40
Ascent rate (m/sec)	3	0.46 ± 0.11	0.43 ± 0.20	0.63 ± 0.28	F = 3.41	0.13
Time at max dept (min)	3	0.8 ± 0.2	1.0 ± 0.4	1.3 ± 0.8	F = 1.21	0.38
Time at max depth (%)	3	45.6 ± 1.8	47.6 ± 1.5	54.7 ± 5.7	F = 7.35	0.10

The average depth of the dives, time at maximum depth, and percentage of time at maximum depth did not change significantly (respectively, p = 0.45, p = 0.38, and p = 0.10). Descent and ascent rates showed no significant differences during the three experimental phases (p = 0.40 and p = 0.13). Although not statistically significant, the frequency of shallow dives was higher before (67%) and during the interaction (64%), than in the post-interaction period (45%) [χ^2 (2, n = 79) = 3.85, p = 0.14].

The results of the repeated measure GLM for diving time and for the ratio surface/diving time are reported in Tables 6.13 and 6.14. Although both of these variables decreased during the interaction with the tour boats and then increased again when the boats left, differences were not statistically significant (p = 0.08 and p = 0.49 respectively). Compliance to the Code of Conduct (interaction of phase*compliance with code) did not have an effect on these two variables (p = 0.09; p = 0.48).

Table 6.13: Descriptive statistics for humpback whale diving time and ratio surface/diving time during the experimental phases of the 2003 study and when the Code of Conduct was followed or breached (n = 9).

VARIABLE		EXPERIMENTAL PHASES			
	SUBJECTS	Pre	During	Post	n
		Ave ± SD	Ave ± SD	Ave ± SD	
Diving time (min)	Code Followed	4.7 ± 3.4	4.5 ± 3.3	6.2 ± 5.4	3
	Code Breached	4.3 ± 2.0	3.9 ± 1.8	4.1 ± 2.0	6
	Total	4.4 ± 2.3	4.1 ± 2.1	4.7 ± 3.1	9
Ratio surface/diving time	Code Followed	1.21 ± 1.10	0.83 ± 0.49	1.02 ± 0.58	3
	Code Breached	2.27 ± 3.12	1.55 ± 1.78	3.47 ± 4.99	6
	Total	1.98 ± 2.70	1.35 ± 1.54	2.80 ± 4.33	9

Table 6.14: Results of the repeated measures GLM for humpback whale diving time and ratio surface/diving time during the experimental phases of the 2003 study and when the Code of Conduct was followed or breached (n = 9).

Tests of Within-Subjects Effects					
DIVING TIME					
Source	Type III Sum of Squares	df	Mean Square	F	p value
Phase	14640.47	2	7320.24	2.95	0.08
Phase * compliance with code	13802.96	2	6901.48	2.78	0.09
error (phase)	44668.44	18	2481.58		
RATIO SURFACE/DIVING TIME					
Source	Type III Sum of Squares	df	Mean Square	F	p value
Phase	4.89	2	2.45	0.75	0.49
Phase * compliance with code	3.62	2	1.81	0.55	0.58
error (phase)	58.97	18	3.27		

6.3.4.2 Horizontal avoidance

The results of the analysis of horizontal responses to tour boat approaches is presented in Tables 6.15 and 6.16.

The index of linearity was lower during the interaction with the boats than in the pre- and post-interaction phases, and the difference approached statistical significance ($p = 0.06$). Compliance with the Code of Conduct did not influence path linearity ($p = 0.35$). Compared to the pre-interaction phase, whales' speed was statistically higher during approaches of boats and in the period after the interaction (GLM, $p = 0.02$, LSD test, $p < 0.05$). Compliance with the code did not affect whale speed ($p = 0.62$) (data for the repeated measure analysis was submitted as one value per individual whale per each phase).

Table 6.15: Descriptive statistics for humpback whale index of linearity and speed during the experimental phases of the 2003 study and when the Code of Conduct was followed or breached.

VARIABLE		EXPERIMENTAL PHASES			
	SUBJECTS	Pre	During	Post	n
		Ave ± SD	Ave ± SD	Ave ± SD	
Index of linearity	Code Followed	0.82	0.22	0.89	1
	Code Breached	0.48 ± 0.36	0.34 ± 0.16	0.56 ± 0.33	6
	Total	0.53 ± 0.35	0.32 ± 0.15	0.61 ± 0.32	7
Speed (m/sec)	Code Followed	0.82 ± 0.64	1.73 ± 1.65	1.49 ± 0.61	2
	Code Breached	0.67 ± 0.22	1.37 ± 0.67	0.86 ± 0.45	6
	Total	0.71 ± 0.31	1.46 ± 0.86	1.02 ± 0.53	8

Table 6.16: Results of the repeated measures GLM for humpback whale index of linearity and speed during the experimental phases of the 2003 study and when the Code of Conduct was followed or breached.

Tests of Within-Subjects Effects					
INDEX OF LINEARITY					
Source	Type III Sum of Squares	df	Mean Square	F	p value
Phase	0.40	2	0.20	3.68	0.06
Phase * compliance with code	0.12	2	0.05	1.07	0.38
error (phase)	0.54	14	0.05		
SPEED					
Source	Type III Sum of Squares	df	Mean Square	F	p value
Phase	***1.93***	***2***	***0.96***	***5.38***	***0.02***
Phase * compliance with code	0.18	2	0.09	0.49	0.62
error (phase)	2.15	16	0.18		
LSD multiple comparison for experimental phases: pre ≠ during; pre ≠ post ($p < 0.05$)					

6.3.4.3 Respiratory parameters and behavioural reactions

Descriptive statistics for respiratory parameters and fluke up times recorded before, during, and after boat-approaches to humpback whales are presented in Table 6.17. Results are also broken down according to tour boat operator compliance or violation of the Code of Conduct (data for the repeated measure analysis was submitted as average per each individual whale per each phase).

Table 6.17: Descriptive statistics for humpback whale respiratory parameters and fluke up times during the experimental phases of the 2003 study and when the Code of Conduct was followed or breached.

VARIABLE		EXPERIMENTAL PHASES			
	SUBJECTS	Pre	During	Post	
		Ave ± SD	Ave ± SD	Ave ± SD	n
Blow interval (sec)	Code Followed	18.5 ± 2.9	24.9 ± 4.7	32.8 ± 25.3	3
	Code Breached	20.0 ± 6.8	20.5 ± 9.2	22.0 ± 9.1	6
	Total	19.5 ± 5.6	22.0 ± 7.9	25.6 ± 15.5	9
Number of blows per surfacing	Code Followed	9.6 ± 5.7	7.0 ± 1.4	10.6 ± 3.6	3
	Code Breached	8.9 ± 2.5	8.6 ± 4.3	8.1± 3.1	6
	Total	9.1 ± 3.5	8.1 ± 3.6	8.9 ± 3.3	9
Blow rate (n of blows/sec)	Code Followed	0.019 ± 0.001	0.019 ± 0.001	0.019 ± 0.001	3
	Code Breached	0.021 ± 0.005	0.021 ± 0.004	0.026 ± 0.017	6
	Total	0.020 ± 0.007	0.020 ± 0.006	0.024 ± 0.015	9
FU times (sec)	Code Followed	4.9 ± 1.9	8.4 ± 2.5	6.0 ± 0.5	2
	Code Breached	8.6 ± 1.7	6.4 ± 1.1	10.1 ± 3.5	5
	Total	7.6 ± 2.4	7.0 ± 1.7	9.0 ± 3.5	7

Although not statistically significant, the blow interval showed an increase during the interaction with the whale-watching boats and in the post-interaction phases (repeated measures GLM, $p = 0.11$). Compliance with the code did not affect the blow interval (repeated measures GLM, $p = 0.26$). The number of blows per surfacing, the blow rate and the fluke up times did not change significantly (repeated measures GLM, lowest $p = 0.10$).

Behavioural frequencies

The results of the analysis of whale behavioural frequencies before during and after the interactions with whale-watching boats are presented in Table 6.18. Results are categorized by tour boat operator compliance with or violation of the Code of Conduct.

When the code was followed there were no significant changes in behavioural frequencies during the pre-interaction, interaction and post-interaction phases [χ^2 (8, n = 500) = 9.55, $p = 0.30$].

When the code was violated, however, frequencies of trumpet blows and tail slashing increased during the interactions with the whale-watching boats [χ^2 (8, n = 1237) = 39.68, $p < 0.01$; standardised residuals respectively = 4.1, $p < 0.01$ and = 2.0, $p < 0.05$]. In the period after the interactions, the frequencies of tail slashing and trumpet blowing both returned to pre-interaction levels [pre- versus post-interaction comparison; χ^2 (4, n = 929) = 8.02, $p = 0.09$].

Table 6.18: Comparison of humpback whale behavioural frequencies when the Code of Conduct was followed (n = 3) or breached (n = 6) (TB = trumpet blows; FU = fluke up; TS = tail slashes).

ANALYSYS OF BEHAVIOURAL FREQUENCIES (Overall)								
CODE WAS FOLLOWED (n = 3)			BEHAVIOUR					
			Blow	FU	Aerial	TB	TS	n
PHASE	Pre	Count	114	14	4	4	0	136
		Percentage	83.9%	10.3%	2.9%	2.9%	-	
		Std. residual	-0.3	0.2	0.6	1.9	-0.9	
	During	Count	88	12	1	1	0	102
		Percentage	86.3%	11.7%	1.0%	1.0%	-	
		Std. residual	0.0	0.6	-0.8	-0.2	-0.8	
	Post	Count	229	23	6	1	3	262
		Percentage	87.4%	8.78%	2.29%	0.38%	1.15%	
		Std. residual	0.2	-0.5	0.1	-1.2	1.1	
	Total	Count	431	49	11	6	3	500
χ^2 (8, n = 500) = 9.55, p = 0.30								
CODE WAS VIOLATED (n = 6; # infractions 3.5 ± 0.9)			BEHAVIOUR					
			Blow	FU	Aerial	TB	TS	n
PHASE	Pre	Count	520	64	6	7	1	598
		Percentage	86.96%	10.7%	1.0%	1.17%	0.17%	
		Std. residual	1.0	-0.7	-0.8	-3.0	-0.7	
	During	Count	234	39	8	24	3	308
		Percentage	75.9%	12.7%	2.6%	***7.8%***	***1.0%***	
		Std. residual	-1.4	0.5	1.8	***4.1***	***2.0***	
	Post	Count	274	42	3	12	0	331
		Percentage	82.8%	12.69%	0.91%	3.6%	-	
		Std. residual	-0.1	0.5	-0.7	0.1	-1.0	
	Total	Count	1028	145	17	43	4	1237
χ^2 (8, n = 1237) = 39.68, p < 0.01								

Considering that frequencies were pooled among different whales, a case-study analysis was performed to control for individual variation. Three of six whales responded to approaches of boats violating the code by increasing instances of trumpet blowing (one also with aerial behaviour and one with tail slashing; vessels were different, Table 6.19). Of the three remaining whales (not reported here), two performed only blows and fluke ups, and one showed aerial behaviour and trumpet blowing during the pre-interaction phase, but differences were not statistically significant [χ^2 (6, n = 235) = 3.87, p = 0.69].

Table 6.19: Behavioural analysis of 3 individual humpback whales that showed responses to boat approaches in violation of the Code of Conduct.

ANALYSYS OF BEHAVIOURAL FREQUENCIES (individual whales)								
Whale ID # 3 (2 infractions)			**BEHAVIOUR**					
			Blow	**FU**	**Aerial**	**TB**	**TS**	**n**
PHASE	**Pre**	Count	132	11	1	2	1	147
		Percentage	89.8%	7.48%	0.68%	1.36%	0.68%	
		Std. residual	1.7	-0.1	-1.9	-3.4	0.5	
	During	Count	27	4	5	15	0	51
		Percentage	53.0%	7.8%	***9.8%***	***29.4%***	-	
		Std. residual	-2.0	0.0	***2.3***	***4.2***	-0.5	
	Post	Count	33	4	3	9	0	49
		Percentage	67.3%	8.2%	6.1%	18.4%	-	
		Std. residual	-0.8	0.1	0.9	1.7	-0.4	
	Total	Count	192	19	9	26	1	247
Whale ID # 10 (4 infractions)			**BEHAVIOUR**					
			Blow	**FU**	**Aerial**	**TB**	**TS**	**n**
	Pre	Count	67	9	1	2	-	79
		Percentage	84.8%	11.4%	1.3%	2.5%	-	
		Std. residual	0.1	-0.1	0.2	-0.5	-	
	During	Count	45	8	1	5	-	59
		Percentage	76.3%	13.5%	1.7%	***8.5%***	-	
		Std. residual	-0.6	0.4	0.5	***2.0***	-	
	Post	Count	49	6	0	0	-	55
		Percentage	89.1%	10.9%	-	-	-	
		Std. residual	0.5	-0.2	-0.8	-1.4	-	
	Total	Count	161	23	2	7	-	193
Whale ID # 14 (4 infractions)			**BEHAVIOUR**					
			Blow	**FU**	**Aerial**	**TB**	**TS**	**n**
PHASE	**Pre**	Count	66	8	1	0	0	75
		Percentage	88.0%	10.7%	1.3%	-	-	
		Std. residual	0.5	-0.5	-0.2	-1.1	-1.1	
	During	Count	26	6	2	3	3	40
		Percentage	65.0%	15.0%	5.0%	***7.5%***	***7.5%***	
		Std. residual	-1.2	0.4	1.6	***2.9***	***2.9***	
	Post	Count	57	9	0	0	0	66
		Percentage	86.4%	13.6%	-	-	-	
		Std. residual	0.4	0.2	-1.0	-1.0	-1.0	
	Total	Count	149	23	3	3	3	181

6.3.5 Effects of code and number of infractions on humpback whale behaviour

Data were collected during 32 trips on 5 different vessels in 2002 (two belonged to the same company). In 8 trips the code was followed, in 24 it was breached. When the code was breached, the number of infractions varied from 1 to 5.

Instances of behaviour recorded (n = 903) included blows (88.8%), fluke ups (7.2%), aerial behaviour (3.0%), trumpet blows (0.67%) and tail slashes (0.33%). These frequencies did not change according to compliance or violation of the code [χ^2 (4, n = 903) = 5.71, p = 0.22).

Descriptive statistics for humpback whale behavioural parameters are presented in Table 6.20. The results of the Mann-Whitney U-test showed that there were no statistical differences in whale behaviour when the operators followed the code or violated it.

Table 6.20: Descriptive statistics and results of the Mann and Whitney U-test for humpback whale behavioural parameters during the 2002 study when the Code of Conduct was followed or breached.

BEHAVIOURAL PARAMETERS	CODE				U-test, p value
	Followed	N	Breached	N	
	Ave ± SD		Ave ± SD		
Blow interval (sec)	33.7 ± 9.5	8	31.6 ± 13.3	24	0.40
Fluke up times (sec)	5.8 ± 0.7	5	6.4 ± 1.2	20	0.09
Diving time (min)	2.8 ± 0.7	8	3.2 ± 1.4	24	0.40
Number of blows per surfacing	5.7 ± 4.1	5	5.1 ± 2.0	18	0.22
Blow rate (n of blows/sec)	0.014 ± 0.002	4	0.015 ± 0.005	16	0.14
Ratio surface/diving time	2.16 ± 2.45	7	1.33 ± 1.70	17	0.89
Index of linearity	0.67 ± 0.27	7	0.63 ± 0.30	17	0.66
Speed (m/sec)	1.68 ± 0.62	7	1.45 ± 0.58	17	0.39

In order to test if an increased number of infractions determined graded changes in behaviour of humpback whales, Univariate GLM analyses were performed. Effects of the vessel that performed the interaction, time of season, and the length of the interaction were also tested. Behavioural parameters considered for this analysis were the same as those presented in Table 6.20. Only one variable showed statistically significant differences – namely, the average blow interval (Tables 6.21 and 6.22).

Table 6.21: Univariate GLM for humpback whale average blow interval in 2002 study, between-subjects factors.

INDEPENDENT VARIABLES	BETWEEN-SUBJECTS FACTORS	N
Vessel	1	8
	2	7
	3	3
	4	10
	5	4
Infractions/min	Range (0 – 0.16)	32
Length of tour boat-whale interaction (min)	10-20	7
	21-30	12
	31-40	7
	>40	6
Time of season	Early (July 1st- 15th)	8
	Mid (July 16th- 31st)	14
	Late (Aug 1st –15th)	10

Table 6.22: Univariate GLM for humpback whale average blow interval in 2002 study, between-subjects effects.

Dependent variable: AVERAGE BLOW INTERVAL (n = 32)

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4237.29	21	201.77	3.90	0.01
Intercept	12918.12	1	12918.11	250.23	<0.01
Vessel	***901.61***	***4***	***225.40***	***4.36***	***0.03***
Number of infractions/min	***2975.23***	***12***	***247.93***	***4.80***	***<0.01***
Length of tour boat-whale interaction	61.01	3	20.34	0.39	0.76
Time of season	354.04	2	177.02	3.42	0.07
Error	516.25	10	51.62		
Total	37887.25	32			
Corrected Total	4753.55	31			

The number of infractions per minute had a significant effect on the average blow interval ($p < 0.01$) (Fig 6.9). When the number of infractions/min increased, the average blow interval increased as well (Linear regression, $R = 0.44$, $p = 0.01$; cases with no infractions were included in the regression, although their high variability reduced the value of the R). Blow intervals also varied according to which vessel performed the interaction, ranging from a minimum average of 27.3 ± 8.9 sec to a maximum of 38.2 ± 14.2 sec ($p = 0.03$). The length of the tour boat-whale interaction and the time of season did not have any significant effects (respectively $p = 0.76$ and $p = 0.07$).

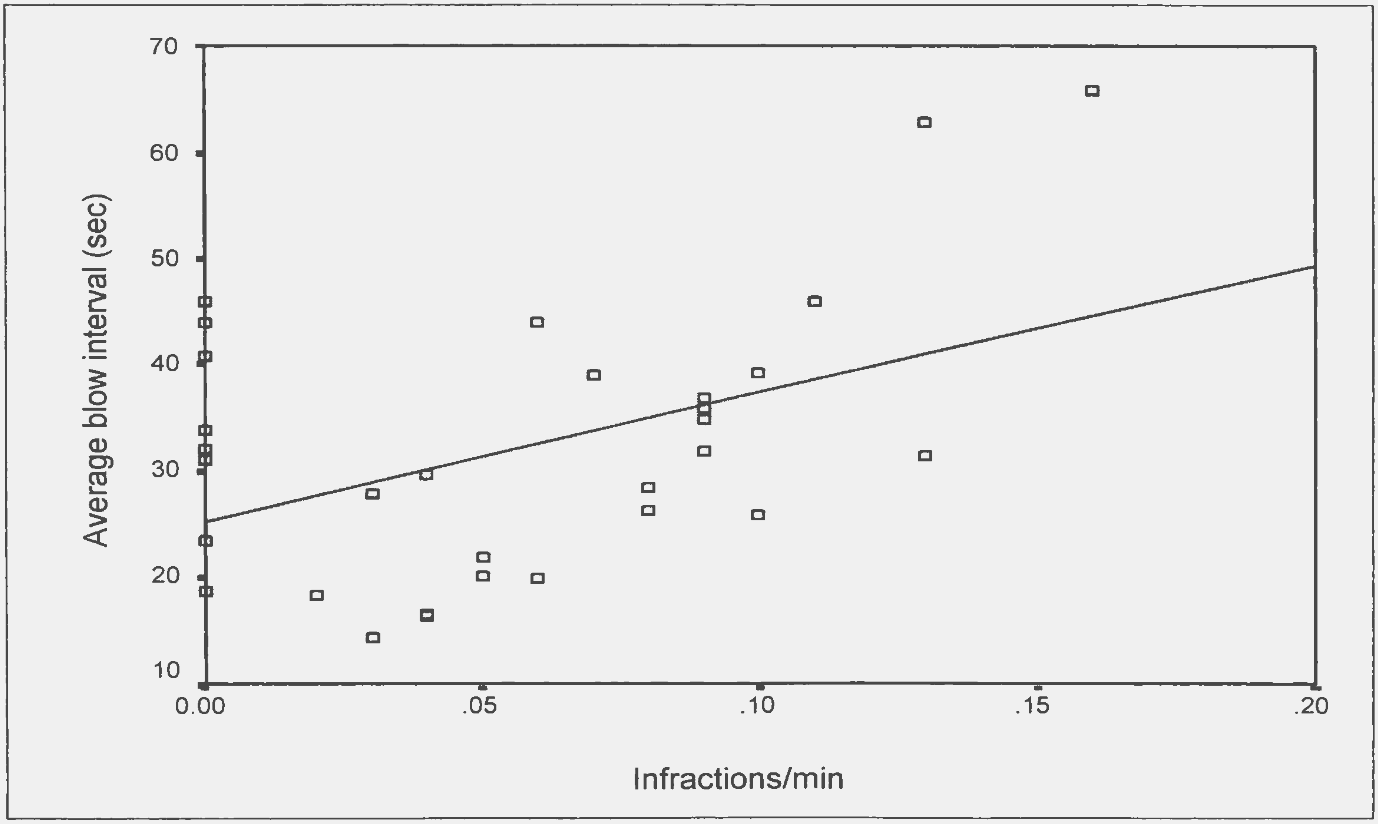

Fig. 6.9: Average blow interval of humpback whales when the number of infractions/min increased (2002 study) (n = 32).

6.4 Discussion

The different methodologies used during this study provided useful information on the biology and ecology of whales in Newfoundland and Labrador, and on the impact of whale watching on humpback whales.

Tagging

The newly introduced technique of tagging whales to measure individual responses to whale-watching boats proved to be revealing, even if the number of tags deployed was low (n = 10). Low deployment-success seems to be a common factor in tagging studies using suction cup attachments. Stone *et al*. (1994) successfully tagged three Hector's dolphins. Schneider *et al*. (1998) successfully tagged 10 bottlenose dolphins, but only 5 tags remained attached for any period of time. In a study on Dall's porpoises (*Phocoenoides dalli*), Hanson and Baird (1994) had only three successful taggings (out of 13 attempts), with only one remaining on long enough to get adequate data. Baird *et al.* (2000) managed to recover diving data for 13 humpback whales tagged in Hawaii (out of 31 attempts). Common factors affecting the success of tag delivery include: the difficulties in accessing animals, weather and sea conditions, problems with tag attachment and loss of suction, electronic failures in the radio and data logger, loss of tags at sea, and, generally, the low number of tags that can be purchased and used due to high manufacturing costs.

In my study the average time tags remained on humpback whales (1.2 ± 0.9 h) was lower than in other studies. In the same species, Baird *et al*. (2000) reported tags remaining attached for an average duration of 4.8 h, while Goodyear (1989) had tags attached for an average of 15 h (n = 12). The shorter attachment duration could be due to differences in tag size (Goodyear's tags did not have a TDR), differences in the attachment and release systems, or differences in whale behaviour. Tag detachment following bursts of aerial behaviour was noticed in at least three cases. It is also interesting to note that the fin whale, a species that does not frequently perform aerial behaviour, had the longest deployment (6.2 h). Differences in skin surface and water turbulence immediately adjacent to the skin may also be important (Fish, 2002). Fin whales have been reported as retaining suction cup tags for up to 3 days (Giard and Michaud, 1997).

During the study, it appeared that whales in pairs (excluding cow-calf pairs) or in groups were easier to approach for tagging, as they seemed to be less wary of the research vessel. Stronger reactions from single humpback whales have been noticed in other locations as well (Bauer, 1986; Clapham and Mattila, 1993; Baird *et al*., 2000).

Impact of tagging on whale behaviour

The main goal of this segment of the study was to evaluate whether suction-cup VHF-TDR tagging had an effect on the behaviour of the study animals. Ethical scientists have to minimise the disturbance and/or pain inflicted to animals under study (quoted in

Brown *et al.*, 1994). Validation of the methodology for testing the impact of whale watching on humpback whales carrying VHF-TDR tags was also important.

Moderate reactions to tagging attempts were most common (42.1%), a finding consistent with Weinrich *et al.* (1992a), but not with the other two studies on humpback whales considered for comparison (Clapham and Mattila, 1993; Brown *et al.*, 1994; Table 6.7). These authors found the most common reaction to be no reaction. Interestingly, the present study showed the highest occurrence of strong reactions (26.4%). There are several possible explanations for these differences.

The likelihood of a strong response did not depend on whether or not the tag actually touched the whales' bodies, indicating that the main source of disturbance was likely the boat's close approach. The animal had to be approached at a distance of 5 m in order to deliver the tag with the pole, while delivery with crossbows, as was performed during the other studies, allowed for distances of 10 - 15 m. Other authors also suggest that humpback whales may be reacting strongly to close vessel approaches, masking the effect of being struck (Clapham and Mattila, 1993; Mate *et al.,* 1998). Indeed, it may be that humpback whales' skin is rather insensitive. Researchers have reported that humpback whales are often more disturbed by biopsy arrows hitting the water surface than by those hitting their bodies (Dr. Jon Lien, personal communication).

Individual differences, behavioural status, and sex may all have played an important role in influencing the response to tagging. For example, animals engaged in feeding behaviour seem less likely to react to the strike of a biopsy dart than those engaged in other types of behaviour (Weinrich *et al.*, 1992a). During this study, most of the animals were engaged in searching behaviour, while actively feeding animals were rarely approached. This is a possible explanation for the higher rates of disturbance found in the current study.

In addition, females have shown lower response thresholds than males (Brown *et al.*, 1994; Gauthier and Sears, 1999). Males also seem to be less sensitive in competitive groups in the breeding ground when already in a state of arousal (Clapham and Mattila, 1993). Except in the case of the humpback cow, it was not possible to determine the sex of the animals during this study. The cow showed a strong reaction to tagging, including tail slashes and lobtails. The presence of her offspring in the vicinity likely contributed to the forceful display (Mann, 2002). Tail slashes have been interpreted as a common display following a threat (Weinrich *et al.*, 1992a; Florez-Gonzalez *et al.*, 1994). One study suggested that tail slashes are a reflex response, as they have been observed in almost all instances when a dart hit an individual (Weinrich *et al.*, 1992a). This does not seem to be the case for my study, however, as tail slashes from the cow and from other adult humpbacks were repeated and directed towards the research vessel.

The analysis of diving patterns subsequent to tagging revealed that the most common reaction of humpback whales was to perform an immediate short shallow dive that lasted less than one minute. This is consistent with studies performed on other species (e.g. sperm whales, Miller *et al.*, 2004; Watwood *et al.*, 2006). In the literature, shallow dives in the presence of whale-watching boats are commonly interpreted as avoidance behaviour, especially if accompanied by abrupt diving and erratic path (Baker and Herman, 1989; Kruse, 1991; Blane and Jaakson, 1995). The occurrence of these dives did not seem to be correlated with the intensity of the responses at the surface, as whales that dove shallowly had shown different immediate responses to tagging. In addition, the only whale that performed a deep dive had shown a moderate reaction to tagging, like two other whales that instead dove shallowly.

It is interesting to note that after the tagging dive, whales rapidly dove again after resurfacing for only a short period of time. The trend in the number of blows and interval between blows (both lower during the first surface period than in the subsequent one) supports the impression that whales performed a shallow dive as a reaction to tagging, as whales were compelled to come back to the surface to finish the ventilation before being able to perform a longer and deeper dive. The third dive was most likely to be a deep dive, indicating that whales at that point were able to resume regular deeper dives, after having spent more time at the surface to replenish oxygen supplies. These deeper dives also had more irregular profiles, suggesting that at this point whales were probably able to resume foraging (Acevedo-Gutiérrez *et al*., 2002).

Analysis of respiration parameters was not possible, as the four adult humpback whales that had sufficient data during the post-tagging period lacked pre-tagging data. Comparisons, therefore, could not be conducted, but other studies have shown no long-term effect of tagging or biopsy sampling on whale breathing patterns (Weinrich *et al.*, 1992a; Clapham and Mattila, 1993; Brown *et al*., 1994; Baird *et al*., 2000).

In conclusion it can be said that the tagging procedures, including failed attempts, may induce some behavioural reactions in humpback whales, but effects are probably only short-term. This makes it a valid methodology for testing the impact of whale watching on humpback whales.

Diving behaviour

Adult humpback whales showed a bimodal distribution in their diving depths, with dives in shallow waters (≤ 25 m) accounting for slightly more than half of all dives. During deeper dives, the average diving depth was just over 50 m, revealing that whales preferentially used lower portions of the water column (water depth average 63 ± 17 m, range 35 – 88 m), and dove to the ocean bottom on one fifth of the deep dives. Diving time, and descent and ascent rates were positively correlated with diving depth.

These findings are in general agreement with other studies of humpback diving behaviour, although some differences are present. Dolphin (1987a; 1987b), for example, did not find a bimodal distribution in the feeding grounds of Alaska (66% of dives were in the first 20 meters of water, 10% in the 21 - 40 m range, 9.0% in the 41 – 60 m range and 15% were deeper than 60 m). The deepest dive was to 148 m (water depth averaged here 369 ± 488 m). In the Hawaiian breeding grounds about 40% of a whale's time is spent in the top 10 m of the water column and about 95% of the time is spent in the top 100 m (Baird, 2000). In Hawaii (where waters depth ranged from 40 to 296 m in depth), the maximum diving depth registered was 176 m (Baird, 2000). The maximum diving depth ever reported for a humpback whale was 240 m (Hamilton *et al.*, 1997). This occurred near Bermuda, where the whale was most likely feeding in the deep scattering layer.

Humpback whales in Witless Bay showed a less pronounced use of shallow waters than in other feeding grounds, and also spent a considerable amount of time in the 41– 60 m range, and in association with the sea bottom. Differences in prey type and distribution may be involved, as these have been shown to influence foraging behaviour of humpback whales (Bredin, 1985, Dolphin, 1987b). Information on prey depth distribution was not collected during the 2003 study, but studies in the same area have shown that while capelin schools preferentially dwell between the surface and the 5° C isotherm (< 20 – 30 m, Methven and Piatt, 1991), they may also be found deeper (< 70 m, Piatt *et al.*, 1989) and near the sea floor (Dr. David Schneider and Dr. John Piatt, personal communications). Although whales could not be directly observed, it is possible that bottom feeding was occurring, as in other locations humpback whales have been observed preying on bottom-dwelling fish (e.g., sandlance; Hain *et al.*, 1995; Clapham *et al.*, 1995). Humpback whales could be using the sea floor to corral schooling fish, as similar strategies for humpback whales have been observed when feeding close to the surface (Hain *et al.*, 1982) and next to the cliffs (Corbelli and Lien, 2003).

Overall, whales in Witless Bay recorded shorter diving times, and slower ascent and descent rates than those reported for other feeding grounds, indicating that dives were most likely limited by the depth of the ocean floor (< 90 m) (Dolphin, 1987a, 1987b). The longest dive was 75% shorter than that reported for the Alaskan feeding grounds (21.1 min) (Dolphin, 1987a, 1987b). The fastest descent and ascent rates were respectively 27% and 36% slower than those reported for humpback whales in Alaska (respectively 2.3 and 2.5 m/sec) (Dolphin, 1987a, 1987b).

The maximum time spent at depth was 32% shorter than the 6.0 min reported by Dolphin (1987a, 1987b), which he also considered the maximum length of time that humpback whales spend at depth regardless of further increases in dive length. It is interesting to notice that animals have been shown to forage more efficiently (in terms of time and energy consumed) in water < 60 m deep and with diving times between 4 - 6 min (Dolphin 1987a, 1987b). This allows them to remain in their aerobic range: utilization of oxygen supplies dramatically increases in deeper waters, and dives deeper than 100 m require 5 times the expenditure than dives in the first 20 m of the water column (Dolphin 1987a, 1987b). Humpback whales in Witless Bay, therefore, seem to be able to forage efficiently on shallow water prey (< 60 m). Other baleen whales are also known to be shallow divers (Brodie *et al*., 1978, Mate *et al*., 1992; Lowrly, 1993).

Prior to the current study, I found no records of tags deployed on humpback whale calves. Along with this calf tagging, a tag was delivered to its mother; the mother's tag, unfortunately, was never retrieved and results are based on data collected at surface. Data indicated that the calf dove, on average, less deeply than adult whales in the same area (37% less for deep dives). The deepest dive was 44% shallower than that recorded for adults. For deep dives, descent and ascent rates were also slower than those of adult whales (- 45% and - 55%). The longest time at depth was 41% shorter than that of adult whales. The average diving time and the longest dive, however, did not show major differences (respectively + 9.3% and – 5.8%).

The mother's average diving time while accompanying the calf was 4.1 ± 1.9 min and the longest dive was of 7.2 min. The diving depth is not available, but studies have shown that this parameter is usually correlated with the length of the dive (Dolphin 1987a, 1987b; Kramer, 1988; this study). Considering the fact that the two whales dove together in 63% of the cases and that the diving times of the mother were comparatively longer, the calf likely did not take part in the deeper dives, but instead, remained in shallower portions of the water column. This may have been due to aerobic limitations (Dolphin, 1987a, 1987b; Mann, 2002). The two whales probably dove together in order to maintain pair cohesion in the first portions of the dives and to reduce the vertical distance between them during the deeper phase of the mother's dives. Stable mother-calf associations have been reported as common for Newfoundland and Labrador, and are due largely to the fact that first-year calves are still nursing (Whitehead, 1983). Additional functions could include predator avoidance behaviour in waters where attacks by killer whales have been reported (Whitehead and Glass, 1985), and reducing energy expenditure for locomotion, with the calf taking advantage of the mothers' water displacement (Brodie, 1977).

The dive analysis of the fin whale in Witless Bay showed that this whale dove more shallowly than what has been reported elsewhere. The deepest dive (almost 70 m) is considered low for these whales, capable of diving to 500 m (Harrison and Kooyman, 1971; Panigada *et al.*, 1999). In addition, the maximum diving time was much shorter than that of whales living in deeper waters (- 80%) (Panigada *et al.*, 1999). Its diving behaviour was obviously limited by the shallow waters of the Witless Bay area. The average diving time was similar to that of non-foraging whales in the Pacific (Acevedo-

Gutiérrez *et al.*, 2002) and to Mediterranean fin whales (Jahoda *et al.*, 2003). Fin whales have been reported feeding in Witless Bay (Piatt *et al.*, 1989; Piatt and Methven, 1992). However, a lack of feeding lunges observed at the surface and at depth indicate that this fin whale most likely was not feeding during the period of observation (Acevedo-Gutiérrez *et al.*, 2002).

Impact of whale-watching boats on humpback whale behaviour

In comparison to previous studies (as reviewed by Bejder and Samuels, 2003), the three different methods used to record humpback whale behaviour in the present research allowed for a broader view of the possible impacts of whale watching.

The present study found that the main effects of tour boat interaction on humpback whale behaviour included increases in blow intervals (2000 and 2002), increases in trumpet blowing (2003), increases in instances of aerial behaviour (2000) and tail slashes (2003), and adoption of horizontal avoidance responses (2003). Compliance with the Code of Conduct had only limited effects.

Respiratory parameters

During this study, changes in blow intervals were found in response to an increasing number of whale-watching vessels approaching whales (> 1), when the number of infractions increased, and in response to approaches by specific vessels. Other respiratory parameters considered for analysis did not change. Compliance to the Code of Conduct did not influence respiratory parameters.

Humpback whale respiratory parameters have been shown to change in response to whale-watching vessel approaches in other studies (Peterson, 2001; Stone *et. al.*, 1992). A decrease in blow interval is interpreted as a sign of disturbance as animals may be trying to reduce time at the surface (i.e. vertical response) (Tinney, 1988; Baker and Herman, 1989; HWRT, 1991; GBRMPA, 2000). However, I found an increase in the interval between blows. Longer blow intervals are usually observed when humpback whales are travelling and moving faster (Whitehead *et al.*, 1979; 1982; Bredin, 1985; Dolphin, 1987b).

When the operators did not follow the Code of Conduct, some whales reacted by producing a significantly higher proportion of trumpet blows during the interaction as compared to the pre- and post-interaction phases, but when boats followed the code this frequency did not change significantly. Trumpet blows are forceful wheezing exhalations that have been reported in humpback whales as responses to: attacks from killer whales (Florez-Gonzalez *et al.*, 1994), biopsy sampling or tagging (Gauthier and Sears, 1999; this study), and dolphins swimming in close proximity to whales' eyes during bow-riding (Würsig, 2002). Humpback whales also perform trumpet blows when caught in fishing gear and during procedures to disentangle them (personal observation). The increase in the number of trumpet blows during the interaction with the code-violating tour boats suggests that whales perceive these interactions as more annoying or threatening.

Aerial behaviour

The frequency of aerial behaviour significantly increased when humpbacks were approached by a whale-watching boat and further increased during the presence of two or more vessels. Aerial behaviour included breaching, lobtailing, flippering and spy-hopping. An increase in tail slashing was also found when the code was breached (although differences were driven by one animal).

It must be noted that when observations were performed from the cliff (2000), a slight bias towards recording the more conspicuous behaviour could have been introduced (Bejder and Samuels, 2003). From land, it was difficult to discern the cause-effect relationship, especially in cases where the number of tour boats around active animals increased. Indeed, operators are known to approach acrobatic animals in order to provide a more exciting experience for the passengers. For this reason, a directional measure of association was used to analyse the data. During the pre-, during, post-interaction study (2003), I was able to follow individual whales from a closer distance and for a longer period of time, allowing for a more accurate recording of behaviour.

While the exact function of aerial behaviour in cetaceans is still debated, breaching has been interpreted to signify extreme annoyance, general arousal and power display (Prior, 1986). Instances of aerial behaviour can happen in response to biopsy sampling or tagging (Dr. Jon Lien, personal communication; Gauthier and Sears, 1999; this study). Other functions attributed to aerial behaviour include vision above water, stretching, breathing during storms, maintaining social cohesion, escaping predators, and acoustic communication, especially during rough weather (Payne and McVay, 1971; Prior, 1986). Breaching is commonly interpreted as a form of play when performed by young animals (Whitehead, 1985). Whatever the function, breaching is a high energy-consuming activity for whales and animals may become fatigued and progressively decrease the portion of body lifted out of the water during prolonged bouts of this activity (Whitehead, 2002).

The function of lobtailing is still subject to speculation but is most commonly considered to have communication and social functions or, as an alternate hypothesis, to play a role in foraging (Jaquet, 2002). Tail slashing is a common whale defence mechanism and has been witnessed during encounters with killer whales as a way to fend off attackers (Florez-Gonzalez *et al.*, 1994; Mann, 2002).

Several studies have found changes in aerial behaviour with vessel presence in Alaska, Hawaii and Australia (Baker, 1988; Baker and Herman, 1989; Corkeron, 1995; Green *et al.*, 1999). Humpback whales in Witless Bay seemed to respond to the presence of whale-watching boats in a similar manner. These whales also presented higher frequencies of aerial behaviour when the number of boats increased (> 1), indicating that this situation may represent a bigger disturbance to them. This scenario may carry some additional costs for animals, directing energy to performing increased aerial behaviour. In these circumstances animals may also miss important foraging opportunities.

It is difficult to discern if whales are performing aerial behaviour as a response to a noisier environment in an effort to maintain social communication or because they perceive the approaching boats as a physical threat and use this behaviour as a power display (Corkeron, 1995). In support of the first hypothesis, studies have found that whales are very sensitive to their acoustic environment and respond differently to whale-watching boats with different engine types and different hull characteristics (Au and Green, 2000; Erbe, 2002). Individual characteristics and previous experiences may also influence how animals respond to vessel sounds. In other situations, humpback whales exposed to the same sound stimuli have responded differently by ceasing to sing, increasing the duration of songs, or by not giving any apparent response (Miller *et al.*, 2000).

Conversely, studies have shown that the sounds produced by whales' aerial behaviour are not very loud underwater, thereby making their contribution to underwater communication fairly minimal (Würsig *et al.*, 1989). Furthermore, the shallow depth of Witless Bay may further decrease the efficacy of this behaviour as a form of communication, as shallow coastal water environments are notably noisier than deeper and open ocean waters (Urick, 1983). If communication is not the main purpose, aerial behaviour may instead serve as a display of power. Testing the acoustic environment of Witless Bay would provide useful information in understanding the function of the aerial response to the whale-watching vessels in this area.

Spatial avoidance

Humpbacks responded to approaches of whale-watching boats by swimming faster and, possibly, having a more erratic path. After tour boat departures, speed remained significantly higher. The Code of Conduct did not modify the animals' spatial responses to the approaches of whale-watching vessels.

Cetaceans live in a three-dimensional environment and have been observed avoiding whale-watching boats by actively increasing horizontal distance (Edds and Macfarlane, 1987; Kruse, 1991; Constantine, 1995; Blane and Jaakson, 1995; Nowacek *et al.*, 2001; Rivarola *et al.*, 2001; Williams *et al.*, 2002a; 2002b; Jahoda *et al.*, 2003) and/or vertical distance from vessels (Baker and Herman 1989; Blane and Jaakson, 1995; Janik and Thompson 1996; Nowacek *et al.,* 2001). Vertical avoidance is usually signaled by an increase in dive duration and a decrease in blow intervals and swim speed, while horizontal avoidance happens with a decrease in dive duration and an increase in blow intervals and swim speed (Baker and Herman, 1989). Both these responses are simple and effective ways to cope with negative stimuli (GBRMPA, 2000). However, some cost for the animal may be involved in terms of more energy consumed (Dolphin, 1987a; 1987b; Williams *et al.*, 2002a), with vertical avoidance considered to be the more demanding of the two (Lusseau, 2003a; 2003b).

In the present study, results indicate the adoption of a horizontal avoidance response to vessels, as whales increased speed at the surface (+ 67%). This interpretation is also corroborated by the trend in path linearity (- 39%). Similar horizontal avoidance strategies for other cetacean species have been reported (Williams *et al.*, 2002a; 2002b).

Humpback whales did not show a vertical response to whale-watching boats in Witless Bay. This may be because not an effective strategy in these shallow waters, although, it is not ruled out that other factors may be at play, including individual differences, higher threshold levels, or the fact that a vertical response may not be part of the behavioural repertoire of this population of whales. Another study has shown that this kind of avoidance strategy likely carries a high metabolic cost, and that cetaceans switch to vertical avoidance only as a last resort (Lusseau, 2003b).

In the present study, there was also no increase in shallow dives as a response to the approaches of the whale-watching boats, which is commonly reported in the literature (Baker and Herman, 1989; Kruse, 1991; Blane and Jaakson, 1995). An increase in shallow dives was, however, observed during the tagging study and, therefore, this kind of behaviour may be more correlated with a startle response. Similar startle responses have been found in terrestrial species (e.g. Artiodactyla) subject to stalking by stealthy predators or in response to human disturbance (Schultz and Bailey, 1978; MacArthur *et al.*, 1982; Webster, 1997). The lack of shallow dives in response to the approaches of the whale-watching boats may be explained by the fact that humpback whales can hear these boats approaching from a distance.

Effect of compliance with the Code of Conduct

Whether or not whale-watching vessels complied with the Code of Conduct had little effect on humpback whale behaviour. Violations of the code were associated with increased trumpet blowing and probably tail slashing as responses to vessel approaches. Compliance or violation of the code, however, did not change the horizontal response, a response apparently more linked to the simple presence of boats than to operator behaviour.

Although there may be limited effects of compliance versus breaching the code when the number of infractions was low, when the number of infractions increased (and/or the number of boats), an increase in blow interval was detected. This may suggest that when interactions became more intrusive, whales were possibly shifting from narrow-ranging activities (like feeding) to wide-ranging activities (like travelling). A shift from tortuous routes to more linear paths has been observed in fin whales when closely approached by a zodiac (Jahoda *et al.*, 2003), and also in killer whales, that switched avoidance mechanisms when boats became too numerous (William *et al.*, 2002a; 2002b). The same authors compared this behaviour with typical predation avoidance behaviour, where an irregular path may be a useful avoidance tactic with a single predator (i.e. boat) but ineffective with more than one (Howland, 1974).

Boat number, boat manoeuvring, and failure to comply with whale-watching regulations have been shown to affect whale behaviour in other locations. Resting behavior of bottlenose dolphins decreased as the number of tour boats increased (Constantine *et al.*, 2004). Short-finned pilot whales responded to increasing numbers of whale-watching vessels by actively avoiding them; when three or more vessels were present the whales showed the strongest reactions (Glen and Butler, 2003). The intensity of responses by beluga whales to vessels increased as the number of boats increased (Blane and Jaakson, 1995). Southern right whales generally moved away from boats that circled them or approached them head on (Campagna *et al.*, 1995; Richardson *et al.*, 1995; Groch *et al.*, 2003). In Ecuador, humpback whale responses to tour boats increased when boats violated local guidelines (e.g. getting too close, performing high-speed or wrong-side approaches, and/or overtaking the group; Felix, 2001).

In 2002, differences in humpback whale blow intervals were also found in response to different vessels. These results suggest that some vessels may be inherently more disturbing to whales regardless of skipper behaviour. Four of the five vessels were quite similar structurally, while one was notably different. A likely explanation is that whales reacted differently to boats' underwater sounds, as this as been found in other locations where whale watching occurs (Au and Green, 2000; McCauley and Cato, 2001). Boats, in fact, are known to vary in regards to underwater sound signatures due to hull size and type, engine size and type, size and condition of propellers, cavitation noises, etc.; McCauley and Cato, 2001). Underwater sound levels, however, were not measured during this study and reaction to visual stimuli is also possible (Watkins, 1986).

Humpback whales in Newfoundland and Labrador could be using a two-step horizontal avoidance. The first step happens in cases of low disturbance (i.e. one boat approach following the code). In these instances, whales respond with increased speed and possibly a more tortuous path. A circuitous escape-route could signify less distance travelled, therefore allowing whales to remain in the same area. This could be particularly important for whales that are engaged in important feeding activities in restricted areas where concentration of fish above a certain threshold makes it energetically convenient to feed (Piatt and Methven, 1989). The lack of change in respiratory parameters during this low level of disturbance is probably due to the fact that these parameters are closely linked to the behavioural statuses in which whales are engaged (Whitehead *et al.*, 1979; Bredin, 1985; Watkins, 1986; Dolphin, 1987b; Richardson and Würsig, 1997). This also indicates that the metabolic rate, which in cetaceans is usually linked to the blow interval (Sumich, 1983; Kriete, 1995), did not change, although some energy would need to be redirected from foraging to the horizontal avoidance strategies. When a single operator breached the code, the increase in trumpet blowing and tail slashing indicated that these interactions were more disturbing to some animals.

The second step occurs when disturbance further increases with the presence of more than two boats or a higher number of infractions. In these cases whales may abandon short-range avoidance mechanisms and start travelling. Due to methodological limitations, individuals could not be followed long enough to confirm this impression, however similar responses have been found for other species in other locations (Williams *et al.*, 2002a; Jahoda *et al.*, 2003; Lusseau, 2005). In these instances, the fact that boat traffic can force animals to swim away from food may carry consequences for animal fitness.

Overall, a threshold level for boat disturbance on humpback whales in Witless Bay could exist. This threshold level is hard to quantify, dependent as it may be on individual whales and their previous experiences with whale-watching boats, and with other factors such as prey concentration and previous foraging opportunities.

From the results of the studies on the impact of tagging and of tour boats on humpback whale behaviour, a tentative scale effect of these activities may be extrapolated (ordinal values). This is presented in Table 6.23.

Table 6.23: Effects of tagging and of whale watching on humpback whale behaviour along with hypothesised cost for the animal.

IMPACT	SCALE	EFFECT	COST FOR THE ANIMAL
No boats	0	-	-
Tagging	1	Short-term immediate evasive reactions	Animals resume normal behaviour almost immediately
Approach by a single whale-watching vessel following the Code of Conduct	2	Horizontal avoidance: increase in speed, (more circuitous path?)	Probable redirection of energy from foraging to swimming faster
Approach by a single whale-watching vessel violating the Code of Conduct	3	Increases in trumpet blowing (and tail-slashing?)	Increase in disturbance, (energy redirected for the surface response?)
Approach by a single whale watching vessel committing a high number of infractions or by a higher number of boats	4	Increases in aerial behaviour; changes in breathing rates and possible travelling	Energy redirected for the surface response, travelling, and possible missed foraging opportunities

Limitations

It should be noted that this study was not intended to be longitudinal; different aspects of the code were investigated in different years, making multiyear comparisons difficult. Some behavioural differences were found during the three years (e.g. the higher frequency of aerial behaviour in 2000). A tempting explanation could be that bringing in the code in 2001 diminished tour boat disturbance on the whales. This hypothesis, however, cannot be corroborated because exact distances between boats and whales were not measured in 2000. Generally, differences found between years are likely due to the varied methodologies applied, whale individual variability (e.g. age, sex, reproductive status, previous experiences with whale-watching vessels, etc.), prey availability and distribution, whale return rates, and other unknown variables that could have changed across years.

Summary of Results

Tagging:

1) Tagging is a feasible procedure for use in evaluating the effect of whale watching on humpback whales (although the low delivery success may limit its potential).
2) Tagging procedures, including failed attempts, may induce some behavioural reactions from humpback whales, but effects are short-term.
3) The most common reaction to tagging was to take short shallow dives.

Whale diving behaviour:

1) Adult humpback whales showed bimodal diving profiles, with slight differences from other feeding grounds; the shallow waters in the Witless Bay area likely restrict diving performance.
2) The humpback whale calf showed relatively limited diving capabilities, perhaps due to its restricted aerobic capacity.
3) Cow-calf diving behaviour was typical of mother-infant whale behaviour.

4) Fin whale diving behaviour was typical of non-foraging animals; again, the shallow waters likely limited diving performance.

Impact of whale-watching boats on humpback whale behaviour:

1) Whales in Witless Bay reacted to the approaches of tour boats with aerial behaviour (2000).
2) Humpback whales responded to approaches of vessels by adopting a horizontal avoidance strategy. This included increased swimming speed and indications of a more tortuous path (2003).
3) No vertical avoidance was noticeable, including no performance of a higher number of shallow dives during boat approaches.
4) The exact costs of tour boat interactions with whales are unknown, but the redirection of energy to increased swimming speed is likely to carry some costs for the animals.

Effects of compliance with the Code of Conduct in reducing boat impact

1) Violations of the code were associated with a higher occurrence of trumpet blows, and possibly of tail slashes; complying with the code, therefore, could diminish disturbance for some whales.

2) Compliance with the code did not influence the occurrence of horizontal responses.

3) An increased blow interval as a response to the presence of two or three vessels and to a higher rate of infractions may suggest the existence of a threshold level for boat disturbance, after which whales may start travelling.

4) By complying with the code, operators may limit the energetic costs of missed foraging opportunities for animals travelling away from the food source – a possible response indicated when interactions became more intrusive.

Chapter 7 - Conclusions

Whale watching is often promoted as an eco-tourist activity. Despite this claim, there are no studies demonstrating that whale watching simultaneously meets all of the criteria generally agreed upon as constituting 'eco-tourism': namely, focus on a flagship species, sustainability, educational benefit, and proper management. To the contrary, previous studies have indicated, and the present study does little to allay the suspicion, that whale watching can have a negative impact on cetaceans, tends to have limited educational benefits, and tends to be poorly managed.

In 2001, responding to concerns about possible impacts of whale watching on cetaceans and as a precautionary measure, a voluntary Code of Conduct for commercial whale watching was developed in Newfoundland and Labrador. In agreement with studies on management of whale watching and other eco-tourist activities, the code was based on adaptive management strategies. This implies a commitment to monitoring and to systematic review of its relevance as a practical method for ensuring a secure habitat for wildlife.

The main objectives of this study were to determine if commercial whale watching in Newfoundland and Labrador could be properly managed with a voluntary Code of Conduct and if it could be designated as an eco-tourist activity. In order to accomplish this, the following steps were taken: 1) information on the extent and development of this activity in Newfoundland and Labrador was gathered; 2) operators were engaged in the study; 3) compliance with code rules was investigated; 4) the educational value of whale watching was assessed; 5) methods to increase the educational value of whale watching trips were devised and evaluated; 6) the feasibility of a passenger-enforced Code of Conduct was evaluated; 7) methodologies to assess the impact of whale-watching vessels on cetaceans were devised and applied; 8) the impact of tour boat interaction on humpback whales was measured; and 9) the effect of the voluntary Code of Conduct in reducing potential impact of whale-watching boats on cetaceans was tested.

Code of Conduct

After the completion of the first whale-watching season with the code, operators declared that it was easy to follow the rules. Most of them considered it good for their business because it made the industry look more professional. Operators reported that passengers were informed about the code. Only one operator reported some minor complaints from passengers of a diminished experience because the code was in place. None of the operators filed reports of non-compliance to ATANL.

The skippers' claim that the code was more challenging to respect in difficult sea or weather conditions was disproved by the results of this study showing that even in such circumstances, or with faster whales, some skippers were able to comply with the rules. The number of infractions was, in fact, largely attributable to which skipper was in charge. Differences among vessels were found in the length of the interaction with the whales and in the number of course change/min, both of which contributed to a higher number of infractions per trip. 'Non-compliant' skippers tended to control the boat-whale interactions, performed a high number of catch-up manoeuvres, and went too close to the whales. Overall, the code was breached on three-fourths of the trips. Tour boat operators in the Witless Bay area used a method of approaching whales that is not compatible with the actual Code of Conduct, given that this method involved actively manoeuvring the boats to enter the 100 m exclusion zone.

It is important to highlight that compliance to the rules of the Code of Conduct did not affect passenger satisfaction. Whale watching in Witless Bay was, overall, a very satisfactory experience for passengers, regardless of the distance from the whales. The findings suggest that whale watchers are concerned about the well being of the animals, favour operations that subscribe to a code, and consider whale watching to be a potential learning experience. From these results, it is clear that violating the rules of the Code of Conduct does not benefit operators.

Educational value

The educational value of whale watching in Newfoundland and Labrador proved to be low and there was no increase in environmental awareness in the passengers subsequent to their trip. These results seem to be linked more to an unsatisfactory interpretation program by operators (or the informal setting) than to other factors such as lack of tourist interest and receptivity. In fact, when a structured educational program was put into place, it proved to be effective in providing information on whale biology. The educational video developed for this study was an effective tool, with effects similar to those of exposing passengers to an educational talk. There was no difficulty in gathering passengers to participate in the educational deliveries while they were waiting to board, demonstrating their receptivity to such initiatives.

The advertising material produced by the tour boat operators was another issue identified in this study. Brochures and websites were designed without incorporating the principles of the code, and misleading pictures and statements were common. In only one case was the voluntary Code of Conduct mentioned, but the 100 m rule was not specified. At least one-third of boat passengers had been exposed to advertising material before their trip. Overall, expectations of whale watchers were inconsistent with code guidelines, as almost three-quarters of passengers anticipated being within 100 m of the whales.

Passenger enforcement of the code

Although most whale watchers were generally aware of the Code of Conduct after the trip, passengers do not seem capable of serving as effective enforcers. Passengers showed poor knowledge of the specific rules of the code, and even when they did know the rules they failed to recognise operator infractions. Whale watchers demonstrated an apparent bias towards a benign view of tour boat operator behaviour, as code-breaching vessel manoeuvres around whales were disregarded or misinterpreted. The very fact that the company had signed onto the code perhaps influenced passengers' judgement, such that they believed no infraction could have taken place.

Tagging

The tagging procedure, never before used in a whale-watching impact assessment, proved to be applicable for evaluating the effect of tour boats (no vertical reaction noticed), although the number of tags delivered was low. This procedure induced some short-term behavioural reactions in humpbacks. The tagging also provided information regarding the general diving behaviour of whales in Witless Bay. Adult humpback whales showed a bimodal distribution in their diving depths, with dives in shallow waters (≤ 25 m) being more common. During deeper dives, whales preferentially used lower portions of the water column and also dove to the sea bottom. The most common depth range was between 40 and 60 m (water depth average 63 ± 17 m), allowing animals to forage efficiently, well within their aerobic limits.

There was no prior intention to tag humpback whale calves, due largely to their susceptibility to disturbance and their known differences in behaviour from adults, which would thereby provide limited value for comparison. To my knowledge, there were no previous diving data collected for these animals in the feeding grounds. Field circumstances allowed tagging to occur without inducing any noticeable reaction in the animal, but the effect of whale-watching boats on this whale was not evaluated. The simultaneous recording of the cow and calf diving behaviour showed that these animals usually remained close together, although the calf probably did not follow the mother in the deepest parts of the dives. This is most likely due to its restricted aerobic capacity, also indicating that these animals would have limited vertical responses to disturbances.

The tagging of the fin whale was also an unplanned event as these whales are only occasional targets of whale watching in Witless Bay. However field circumstances again made this procedure possible without a noticeable disturbance to the whale. Unfortunately there was no occasion to tag other specimens, making a statistical comparison with other individuals and the testing of whale-watching impact on this species impossible. Nevertheless, data retrieved were useful to determine the applicability of this procedure for fin whales and to gather information on their diving behaviour in Witless Bay.

Methodologies for studying the effect of whale-watching boats on humpback whale behaviour.

My study included three different methodologies for testing the impact of whale-watching boats on humpback whales. These entailed observing whale behaviour from land, from the tour boats and from an independent research vessel. These three approaches were applied in three different years. Different experimental questions were also asked every year. While this allowed for a comprehensive study of the behavioural reactions of humpback whales to tour boats, inter-annual comparisons were hindered. The impact study could therefore better be defined as a '*range-finding study*', (i.e. one that provides general insights on the range of responses that can be measured). Applying these three methodologies simultaneously would have provided a better test, however, this could not be accomplished for logistical reasons.

The 2000 land-based study considered the effects of the presence/absence of boats and approaches by multiple boats. Compared to the other years, this study provided larger samples (92 focal follows), but the distance of the observational point from the boat-whale interactions (0.5 - 3 km range) was a limiting factor. This did not allow for the recording of more detailed behaviour (e.g. trumpet blows) and it made focal-animal sampling more difficult. Focal-animal sampling was chosen, as it was considered to provide the best behavioural data for studies of impact assessment (Bejder and Samuels, 2003). Other possible behavioural sampling methods (e.g., group follows with scan, predominant activity, or one-zero sampling) have their own drawbacks, including higher likelihood of over-reporting conspicuous behaviour and the need to consider split/re-joining rates.

The 2002 tour boat-based study focussed on the effects of compliance with the code and the effects of varied numbers of code infractions. This methodology provided easy access and closer proximity to the whales, allowing for more precise collection of behavioural data and recording of boat-whale distances. The fact that whales could not be studied after boat departure was, however, a serious limitation. For this study (and for 2000), in fact, increases in blow intervals during more intrusive approaches may have indicated changes from short- to long-range avoidance mechanisms, but individuals could not be followed long enough to confirm this impression.

The 2003 research vessel-based study focussed on whale behaviour before, during, and after the interactions with tour boats. This methodology seemed particularly promising in testing the effects of whale watching, although sample sizes ended up being quite small due to the difficulties in delivering tags. For this reason, no finer scale than compliance vs non-compliance to the code could be included in the analysis. Generally, studies on the impact of whale watching have been performed through opportunistic observation (and therefore with little or no manipulation of independent variables) or through experimental approaches (where researchers control the terms of the interactions, limiting applicability to 'real world' scenarios). The methodology used in 2003 was innovative and effectively brought 'the laboratory into the field', along the same lines as the *'meso-cosmos'* techniques in ecotoxicology utilised in environmental impact analysis (Bacci, 1993). In this study, variables could be manipulated but at the same time the effects of 'real-life' whale-watching activities could be monitored. Tour boat approaches were arranged and 'unwanted' approaches by other tour boats were controlled during the pre- and post-interaction phases. By using the same experimental animal as control, treatment and post-treatment subject, the problem of inter-individual variability could be controlled. As shown by the case studies, responses of individual whales were indeed very different. Carrying out a trial consecutively and calculating behavioural parameters as averages for each phase allowed external effects (e.g., of location, time of day, prey distributions and other unknown variables) to be controlled as well.

One limitation of this study is the possible confounding effects of the presence of the research vessel. As such, this study could be better defined as: "testing the additional effects of whale-watching vessels on the behaviour of humpback whales when already followed by a research vessel" (as it is also defined in the literature, e.g. Corkeron, 1995; Jahoda *et al.*, 2003). An effort to maintain the effect of the research vessel as a 'constant' during the three phases of the 2003 study was undertaken (reduced noise, slow speed, distance from the whales > 100 m). Performing a simultaneous study from the land could have teased potential effects of the research vessel apart from those of the tour boats.

During this thesis, differences among vessels were not investigated. Instead, the focus was on operator behaviour and compliance with the code. Including details of operators' boats in the analysis was considered unethical, as it would enable specific companies to be identified and possibly targeted by authorities or competing tour boat companies as code violators. I am aware that by selecting this procedure I may have limited some specific comparisons with other locales. However, the selection of Witless Bay, the area with the highest impact, and the humpback whale as a keystone species should make the results found here applicable to other places and other species targeted in Newfoundland and Labrador. The type of whale-watching operations in this province is in fact quite homogenous, with local people, most commonly ex-fishermen, owning whale-watching companies in their own communities. (In this province external revenue leakage is not an issue as of yet). Most boats used for whale watching are in-board (diesel engine), including several converted fishing vessels (i.e., Cape Islanders). Boats are also sometimes sold from one operator to another (and from one location to another), as activities are started, terminated or expanded, making the whale watching fleet very similar overall. Finally, consistent with a new paradigm in community-based conservation (Berkes, 2004), the research in this thesis followed a 'place-based model'; for *sustainability science* (where scientists and stakeholders interact to define important questions): “understanding the dynamic interaction between nature and society requires case studies situated in particular places” (Kates *et al.*, 2001).

Impact study

The main finding from the impact study was that humpback whales in Witless Bay react to approaches of tour boats. One response was to adopt a horizontal avoidance strategy (2003). This included increased swimming speed and, possibly, a more tortuous path. In 2000, an increase in aerial behaviour also occurred when whales where approached by tour boats. Aerial behaviour, especially breaching, consumes a great deal of energy, so this may entail additional energy expenditure for the animals. Overall, no vertical avoidance was noticeable, including no increase in shallow dives during boat approaches. In most cases, respiratory parameters did not vary, indicating no increased metabolic demand, however, some interference with feeding activities and some redirection of energy expenditures from diving into swimming faster may have occurred.

Compliance versus non-compliance to the code

Compliance or violation of the Code of Conduct had minor effects on humpback whale behaviour. During approaches in compliance with the code the frequencies of trumpet blows and of tail slashing were lower. This may indicate that these interactions were less disturbing for whales, as trumpet blows and tail slashing are usually performed as a response to a threat or annoyance. Respecting the Code of Conduct did not, however, limit the occurrence of the short-range horizontal response, a response linked to the simple presence of boats.

Although there was little difference in whale behaviour when the strict effects of compliance versus violation were investigated, the results showed that changes in respiratory parameters took place when disturbance was higher. With the presence of two or three vessels and a higher number of infractions, whale blow intervals increased, suggesting that in these circumstances whales were shifting from foraging to travelling. In these cases, missing foraging opportunities may carry repercussions for animal fitness.

Overall, operator compliance with the Code of Conduct was low (see Chapter 4), and statistically, the code made little difference on humpback whale behaviour when the number of infractions was kept low. Nevertheless, two major points underline the importance of maintaining this (or possibly introducing a stricter) form of regulation: 1) the code may limit the number of more intrusive approaches, thereby reducing higher-scale effects on the whales; 2) the code seems to make a difference for individual whales.

Comparison of key statement of the Code of Conduct with the results of this thesis

In Table 7.1, I present a summary of the results and a comparison with some of the key statements to which tour boat operators agreed when they signed onto the code.

Table 7.1: Comparison of key statements of the voluntary Code of Conduct for Newfoundland and Labrador with the results of this study.

CODE OF CONDUCT STATEMENT	FINDINGS OF THIS STUDY
We will participate in training programs so that our staff has accurate, in-depth and up-to-date information on the marine environment and its inhabitants.	Participation in workshops never exceeded 20% of operators that signed onto the code.
We will report to the appropriate authorities any misconduct that is deemed to have a negative impact on the marine environment.	No reports of non-compliance have been filed by any of the operators to date; during this study the code was violated on 73% of trips
Prior to whale-watching tours, we will encourage realistic expectations of encounters with whales to avoid disappointing our customers and to reduce pressure from them to undertake risky vessel activities.	Advertising material was inconsistent with code principles, always picturing whales close to vessels. The 100 m rule was never mentioned. Seventy-two per cent of passengers expected to be within 100 m from the whales.
We will operate our vessel in a manner that does not disturb whales. Harassment is indicated when the animal changes its behaviour because of our presence or activities. A change in behaviour is observed when whales change their swimming direction or speed, when they cease or increase specific behaviours, or when they leave an area.	Tour boat activities caused whales to swim faster and (possibly) change their direction more often than when boats were absent. Other changes in behaviour included increases in aerial behaviour, trumpet blowing and tail slashing. More disruptive boat behaviour may have also caused whales to switch into travelling patterns.
When we are within 100 m from whales we will not try to get any closer to them.	In 33% of the trips in 2002 and in 48% of trips in 2004, operators manoeuvred their boat to further decrease the distance from the whales when already closer than 100m (defined as infraction #2).
When animals are within 100 m of our vessel we will allow the whales to completely control the interaction and operate the vessel with due caution.	
We will not pursue or chase whales.	The most likely direction of whales was away from the whale-watching vessels (69%). When whales were heading away, boat-whale interactions lasted on average 37% longer.
	In 83% (2002) and 72% (2004) of the cases when the boat–whale distance was less than 100 m, it was because the operators had breached the 100 m exclusion zone (defined as infraction #1).
We will ensure that animals are not surrounded by boats by giving way when more than two boats are within 100 m from whales.	In 3% (2004) of the trips a boat approached a whale when two vessels were already performing an interaction with that animal (defined as infraction #3).
We will not cut across animals' path but we will approach slowly from the rear, parallel to animals' path.	In 16% (2004) of the trips a boat approached a whale from the front or from the side (defined as infraction #4).
We will provide passengers with accurate, up to date information about whales, and information about their role in the ecosystem. We will urge them to appreciate and support the conservation of animals and preservation of the marine habitat animals requires.	There was only little gain in knowledge of humpback whale biology after passengers had gone whale watching. Passengers also did not show any gain in awareness of conservation issues, nor showed intent to get more involved in conservation in the future.
We will encourage research and co-operate with researchers that examine the impact of our boats on whales and the marine environment.	Operators provided full collaboration to monitor and to determine the impact of commercial whale-watching activities on humpback whales in Newfoundland and Labrador.

Possible reasons for non-compliance

The extremely low compliance to the rules of the Code of Conduct and to its basic principles is a concern for the management of whale watching in Newfoundland and Labrador. Unsuccessful forms of management may provide a false sense of security that policies to protect wildlife are in place, thereby relieving pressure for other more meaningful conservation actions to be implemented (Reeves, 2002).

This lack of compliance was unexpected because operators voluntarily signed up for the Code of Conduct. Indeed, some of them were strongly advocating for the code and were trying to involve other operators in the province. Operators also showed concern towards other whale conservation issues. For example, they reported cases in which whales were carrying fishing gear and helped with logistics during entrapments. They documented cases in which other boats (e.g. fishery patrols or tourist vessels) entered the reserve or when these boats were speeding in the vicinity of whales. Furthermore, they seemed to understand that minimising boat disturbance to humpback whales was necessary in order to maintain an abundant and thriving population of whales in Witless Bay and thus, a sustainable and remunerative business.

There are several possible reasons for the low compliance to the Code of Conduct. The first one is that tour boat operators commit infractions because they are not aware of breaching the code. This could be because they are not able to judge the 100 m minimum distance. Operators do not carry range finders on board, and estimating distances at sea has proven to be difficult. It is also possible that operators do not comprehend that when going parallel with whales, a 100 m distance should always be maintained, adjusting boat speed to whale speed. It was common to observe skippers starting to follow a whale from outside 100 m (in compliance with the code), but with boat speed slightly higher than whale cruising speed. At each whale resurfacing, they therefore slowly crept a little closer until the boat was well within 100 m of the whale. This boat manoeuvring seems 'acceptable' as a whale is approached parallel from behind, without giving the impression that the boat is 'chasing' whales. When distances were measured, operators almost inevitably manoeuvred their boats within 100 m from the whales. Thus, by failing to adopt a proper speed operators were breaching the Code of Conduct.

The third reason for non-compliance may be an inherent difficulty in following the rules. However, for the most part, skippers are expert mariners and during this study were observed performing boat manoeuvres much more difficult than merely maintaining a 100 m distance from a whale. Some skippers managed to respect the code more consistently than did others, demonstrating that the rules can be followed.

Another factor could be a lack of peer pressure and/or passenger enforcement (only one complaint has been filed to ATANL). The absence of pressure from HNL and the fact that there were no repercussions for breaching the code likely contributes to the laxness. In addition, most of the operators apparently do not understand the benefits that the Code of Conduct could provide in terms of marketing for the whale-watching industry, and did not include information about the code in their advertising.

Finally, operators seem to have a generally benign view of the effect of their operations on the whales. This attitude has several explanations. Some of the skippers in

Witless Bay have been performing interactions with humpback whales for 20 years. Their modus operandi has guaranteed them close encounters with whales throughout this period, without obvious permanent shifts or reductions in whale population. Certain whale behavioural reactions probably pass unnoticed by the operators. As demonstrated in this study, some effects of boat interactions are evident only if compared to periods before and after boats are present. Certain behavioural reactions, however, did become more noticeable in cases where the code was not respected. These may be overlooked or sometimes conveniently 'interpreted' as, for example, cases of increased aerial behaviour being explained as 'the whales putting on a show for us'. Furthermore, operators claim the role of 'environmental ambassador', an image that they use to legitimate their operations, yet the assumption that whale watching provides an educational experience for passengers is unjustified. Finally, operators may try to downplay possible impacts of their operation on the whales out of fear that if serious impacts of whale watching on humpback whales are demonstrated then their businesses could be in jeopardy or subject to Federal regulations.

Recommendations

The voluntary Code of Conduct for whale watching in Newfoundland and Labrador was introduced in response to the DFO-proposed amendments to the Marine Mammal Regulations that would require a licence for operators and stricter rules. It was hoped that the Code of Conduct, if demonstrated to be successful, would preclude the need for additional regulations.

The findings from this research show that compliance with the Code of Conduct may help reduce some of the effects of tour boats on humpback whale behaviour, especially of the more obtrusive interactions. The potential benefits, however, were limited by a general lack of compliance. The management agencies involved in the development of this code have at least three options: the first is to maintain this form of management, but revise the voluntary Code of Conduct by introducing some modifications to increase its effectiveness and operator compliance with its rules; the second is to adopt a set of regulations that would require a licensing process and external enforcement; the third alternative is to adopt a blend of the two. In order to aid decision-makers in this process, recommendations for the management of whale watching in Newfoundland and Labrador with specific attention to the Witless Bay area are provided. These suggestions are based on the results of this study and on my personal observations.

Recommendation for improving the Code of Conduct and operator compliance

1) Some rewording of the code of conduct should be considered. The code specifies that: “operators once within 100 m will not try to get closer” and “operators will not pursue or chase whales.” What is not addressed is how the operators get within 100 m of the whales. Therefore, the previous two statements should be

replaced with: "operators will not use speed and/or course changes to get or remain closer than 100 m from a whale."

2) The 100 m minimum distance approach rule showed some relevance. It may nevertheless be prudent to increase this distance as whales were also shown to react to vessels in compliance with the code. A precautionary approach would be to double this distance (200 m). The effects of the new distance should then be tested. This suggestion is only tentative, as there is no current biological data indicating a specific distance. If future research indicates a need to increase the distance, such an increase should be made.

3) The present Code of Conduct allows two vessels to approach a whale at the same time. However, the higher rates of aerial behaviour shown during the presence of two vessels may suggest that these approaches are more disturbing than a single vessel approach. Maximum number of boats allowed should be reduced to one.

4) On-site training programs for tour boat operators should be implemented. Operators must be made aware of how often they breach the code and that violating the code may have an effect on some animals. During the whale-watching season, a dedicated person - a member of the University or DFO - could conduct sessions with tour boat operators. Training sessions should take place at least twice in a season with the trainer accompanying the skippers on trips and monitoring approaches to the whales. In order to be effective, the trainer should immediately point out instances in which the code is not respected (and identify potential responses from the whales like trumpet blows, tail slashing, etc.).

Suggestions on how to operate the vessel according to the code should be provided.

5) None of the operators are currently using range finders to determine boat-whale distances. The use of these devices should be made compulsory for tour boat operators signed onto the code, as they would be useful aids in maintaining an appropriate distance from the whales.

Recommendations for improving the educational value of whale watching

1) Operators should be informed that passengers value the information provided to them and consider a good educational program to be an important component of a whale-watching experience.
2) Tour boat operators should revise their advertising material and publicise the voluntary Code of Conduct. Images should depict real whale-watching scenarios, and emphasis on 'sensational' pictures should be diminished. Such revisions would likely help in reducing passenger expectations, and would be more consistent with code principles.
3) Attendance at the pre-season tour boat operator meeting organized by the Department of Tourism should be made compulsory for companies that wish to maintain their subscription to the code. Efforts should also be made to involve tour boat operators that have not yet signed onto the code. In this way, they could

begin to understand the marketing advantages and the benefits to the animals of signing onto (and respecting) the Code of Conduct.

4) Institute formalised training for tour boat guides. Operators that sign onto the code would be required to hire interpreters that have completed an accreditation program offered by the Department of Tourism, which is currently in place in Newfoundland and Labrador for other tourist activities.

5) Make available the educational video on the biology of humpback whales and on the Code of Conduct developed by the investigators. Operators could set up a video installation at their facilities and show the video to the passengers prior to departure. Passengers seem to appreciate such educational initiatives, which also lend an aspect of professionalism to the whale-watching company.

6) Evaluate the standards of the educational programs offered and the messages delivered by the tour boat operators. An evaluation could be performed in conjunction with the *in situ* training program for the skippers.

7) In order to facilitate the movement from learning to action, tourists should be given some way of acting immediately. There could, for example, be petitions to sign regarding specific issues of marine conservation, and/or information pamphlets with overviews and contact information for various environmental groups and pertinent governmental departments, and/or lists of practical strategies for conservation in day-to-day life.

Management issues for the Witless Bay area: some key considerations

There are several problems in the management of whale watching in the Witless Bay area. The biggest problem is that, aside from the recently introduced voluntary Code of Conduct, there are no other forms of regulations to control the scale of whale-watching operations.

The Provincial Government of Newfoundland and Labrador grants licenses for entering the Witless Bay Ecological Reserve, comprised of four islands with a 1 km boundary around them. This boundary is set to protect nesting birds. However, a great deal of whale watching occurs outside the boundary of the reserve where no licensing program is in place for these activities. Commercial whale watching is allowable, as long as operators do not enter the Ecological Reserve, which is something they nevertheless do (personal observation). The lack of a licensing program for whale watching also means that there are no specifications on the number and type of vessels that each company can use. Operators in the area are using this lack of legislation to enlarge their operations and to build faster and bigger boats. Some of these vessels reach speeds of up to 20-25 knots (taking only one third of the time of other boats to get to the Ecological Reserve). The total length of the trips has been reduced from 2.5 h to 1.5 h, in order to perform more trips. These vessels travel across areas where whales are abundant. Studies show that the majority of lethal boat strikes occur when vessels are going faster than 14 knots (see Chapter 2). It is the author's opinion that the occurrence of a collision in the Witless Bay area is only a matter of time, given that these have already occurred in other locations where whale watching takes place. This is also a matter of concern for the Department of Transportation as there is a potential danger for the passengers as well.

It is disturbing that there was no requirement for whale-watching operations to provide an impact assessment before implementing new, larger, faster and louder vessels in this sensitive area. There was no 'precautionary' foresight in the Newfoundland and Labrador Provincial Government concerning the particular impacts that different kinds of vessels may have in the area. A specific licensing program for whale watching based on number and type of vessels used should be introduced as soon as possible.

One possible way to manage whale watching in Witless Bay would be to adopt a strategy that blends statutory and voluntary measures. In order to accomplish this kind of management approach, Witless Bay should be up-graded from an Ecological Reserve to a Marine Protected Area or to a National Marine Conservation Area. Under those circumstances the boundaries for protection would be extended from the 1-km radius around the islands to the entire larger area in which whale-watching operations occur. The government could control the issuing of permits that would be necessary in order to enter the area for whale watching. The development of new commercial activities would be screened, and recreational whale watching and access for other vessels (e.g. sea-doos) would be restricted. General regulations could limit the speed of the vessels within this sensitive area while the revised Code of Conduct could regulate the behaviour of boats in proximity to whales, potentially reducing the need for enforcement (Baxter, 1993; Scarpaci *et al.*, 2003). Conversely, if compliance proved unsatisfactory wardens could be put in place, as happened in the Saguenay-St. Lawrence Marine Park, QB.

A levy or surcharge to support the management of and enforcement within the area should be considered and this could be shared between the passengers and the operators. Passengers declared their willingness to pay an increased price for the ticket if this money goes directly into research or protection of the local area. Such a regime is in place in other whale-watching locations such as the Bay of Fundy, NB (www.new-brunswick.net/new-brunswick/whales/ethics.html).

Long-term impacts and suggestions for further research

The assessment of tour boat impact on humpback whales revealed that whales showed some reactions to the presence of whale-watching vessels in Witless Bay, a number of which may have involved energy redirection, missed foraging opportunities, and fewer chances to socialise and rest.

In addition, when exposed to adverse stimuli, other studies have shown that cetaceans can build up a stress response (see Chapter 2). The responses of humpbacks to whale-watching boats in Witless Bay indicate that some animals could be displaying a typical fight or flight response (i.e. increased surface activity or horizontal avoidance). It is not known whether or not these responses lead to an adrenal and a corticosteroid response. If biochemical stress responses are occurring and they are protracted or repeated over time, long-term consequences for animal health are possible. An early attempt within this research project to measure the biochemical stress response from biopsies was abandoned due to methodological and analytical limitations.

The long-term impact of whale watching should be investigated, given that whales in other locations have shown reduced usage or abandonment of areas when impacts become too onerous. A multi-year project to monitor population numbers of humpback whales in Witless Bay and to determine their inter-annual variation should be undertaken to see if there are repercussions at the population level.

More research is needed to understand the amount of whale-watching attention to which humpback whales are subjected during a feeding season in Newfoundland and Labrador. While whale residency in Witless Bay was not studied, in general humpback whales have been shown to remain for only short periods in any particular feeding location during their northern migration (Whitehead *et al.*, 1982). Residency in Witless Bay seems to vary according to prey distribution, time of season, and weather conditions, but rarely exceeds one week (personal observation and various whale-watching captains/company owners communications). Operators are also of the opinion that no more than 80 individual whales visit the area every summer (in 1989 Piatt *et al*. estimated between 50 - 100 individuals), but it is not known how many of the same whales return repeatedly each year. I managed to photo-identify 70 humpback whales during the 2002 study, representing 0.6% of the entire North Atlantic population as estimated by Stevick *et al*. (2003).

Based on the amount of whale-watching activity in Witless Bay (see Chapter 3), I estimate that, assuming for equal distribution of boat activity dedicated to individual whales, there would be approximately 17 h of directed whale watching per individual whale. This represents a substantial amount (about 10%) of the total time (one week, nights included) each whale likely spends in Witless Bay. (This percentage may change with different individuals; surface-active animals, for example, may be subject to a higher amount of whale watching than less visible individuals). Such a calculation should be made for all other locations where commercial whale watching occurs in Newfoundland and Labrador, as this would give a clearer picture of the amount of time whales are targeted by tour boats in this province during a feeding season. Ultimately, we need to consider the proportion of animals affected by the whale-watching industry in relation to the West North Atlantic population. We could then grasp the extent of the overall impact on the whales, as it is the population as a whole that must support the burden of whale watching in order to thrive.

Finally, it must be stressed that whale watching is only one of the possible threats that this population is currently facing. The North Atlantic population of humpback whales is thought to be still recovering from the past impact of whaling (Clapham *et al.*, 1999; Stevick *et al.*, 2003). More recent impacts include ship-strikes, entrapment in fishing gear, and possible reduction of prey (Baird, 2003). In addition, this population also faces potential sources of disturbance from seismic activities in important habitats in the Grand Banks and from other human activities in the breeding grounds (Baird, 2003). Certain segments of the population tend to be particularly susceptible to such threats, including mother-calf pairs, juvenile animals, injured or sick animals, and animals engaged in important life-history processes.

Final considerations

From a management point of view, whale watching can be defined as a direct, but unintentional, threat to humpback whales. This means that humans consciously decide to expose animals to whale watching with the belief that this activity is not causing any harm to the species, or that the harms are balanced out by the benefits. However past research has shown, and the present study corroborates, that whale-watching activities affect whale behaviour, especially when this activity is unregulated. Given the past mistakes in human management of cetaceans and the success of the application of the precautionary approach (e.g., whaling issues), there is every reason to apply such prudence to the management of whale watching.

In conclusion, it can be said that whale watching in Newfoundland and Labrador, as it is currently implemented, is not yet meeting the basic principles of eco-tourist activities. There are, in fact, indications of short-term effects on the target species. In addition, whale watching in this province showed low educational value and signs of inadequate management.

Considering the results of this thesis, and the present commitment of DFO to the precautionary principle, the time has come for serious reconsideration and revision of management and tour boat practices. The recent increase in whale-watching activities in Newfoundland and Labrador, the past and ongoing shortcomings in whale management, and the existence of other less controllable anthropogenic threats make this an even more pressing issue. Ultimately, management authorities must work to minimise the impact of whale watching on humpback whales in this province.

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Personal communications

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Whale-watching captains/company owners, Witless Bay Area, Newfoundland, Canada: Joseph, Loyola, and Michael O'Brien's, Wayne Mulloney, Jerry William (O'Brien's, Bay Bulls); Al Gatherall, John Chidley, Jim Stone (Gatherall's, Bay Bulls); Martha Mullowney, Jerry Dalton (Mullowney's, Bay Bulls); Dave Bennet (Captain Murphy's, Witless Bay); Tom Reddick (Molly Bawn Whale and Puffin Tours, Witless Bay); Keith Colbert (Colbert Seabird Puffin and Whale Tour, Bauline East); Jerry Colbert (Ocean Adventures, Bauline East).

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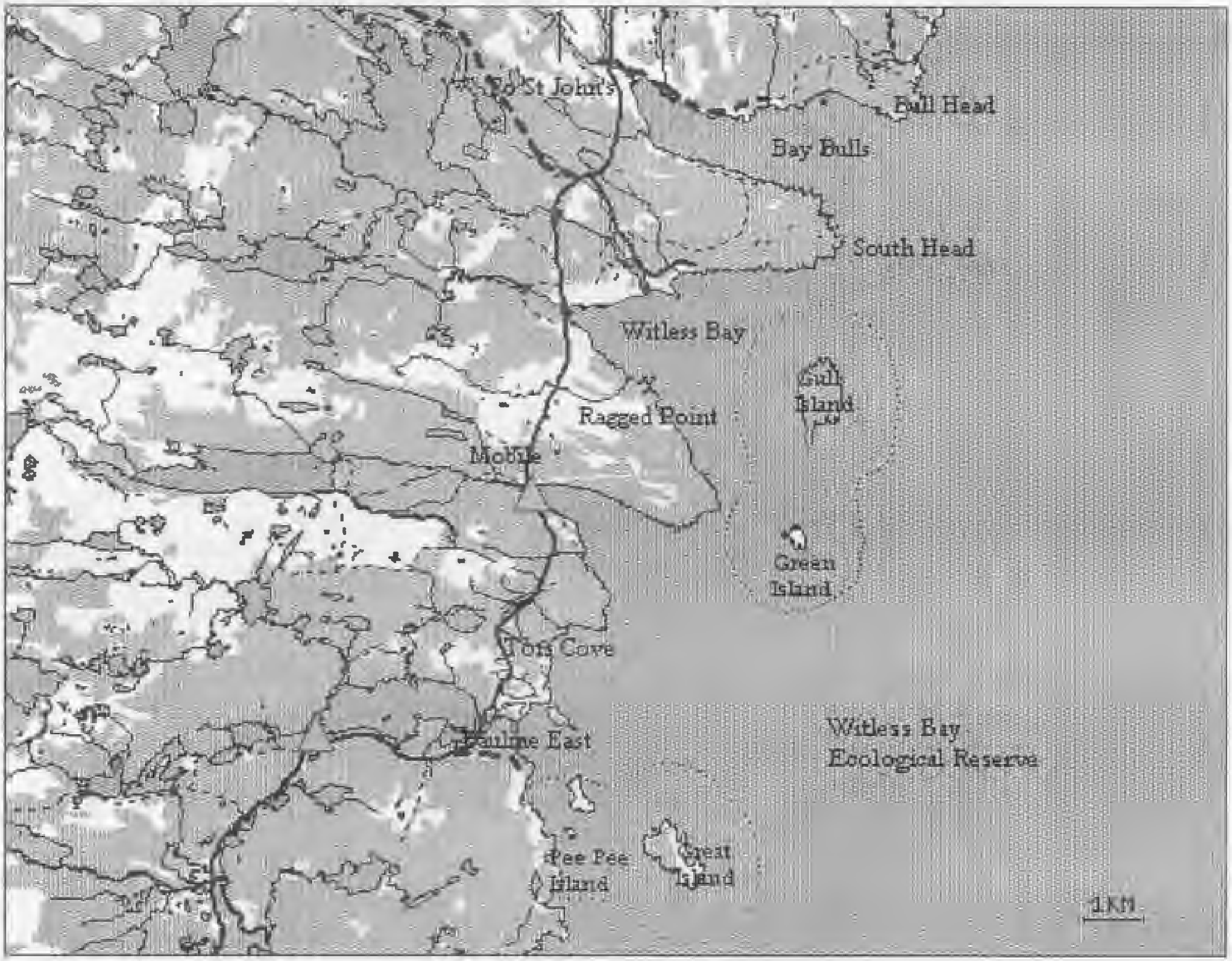
Appendix A: Map of Witless Bay



Witless Bay (47° 16.367' N; 52° 48.699' W) is located 30 km south of St. John's, the capital of Newfoundland and Labrador. Four islands (Gull, Green, Great and Pee Pee) and a one-kilometre marine boundary around them are protected under the Witless Bay Ecological Reserve. The main departure harbours for tour boats are located in the communities of Bay Bulls, Witless Bay and Bauline East. For the 2000 study an observational station was established in Ragged Point (47° 15.905' N; 52° 48.786' W).

Appendix B: Tour boat operator survey protocol (2004)

Contact name: Name of the company:

1) Where is the location of your tour?______________________________

2) How many years have you been operating?:______________________________

3) How many people are hired helpers in your enterprise ?:______________________________

Boat info

4) How many boats do you operate?:______________________________

	Boat 1	**Boat 2**
Type of boat	Long liner – catamaran - zodiac	Long liner – catamaran – zodiac
Length (feet)		
Engine type	In-board Out-board Hp______ 2 strokes 4 strokes	In-board Out-board Hp__________ 2 strokes 4 strokes
Propeller	Caged Prop Guard no protection	Caged Prop Guard no protection
Load capacity		
Upgrades		
New boats added?		

4) Do you provide any other service beside the tour boat? YES NO
restaurant gift shop other tours more______________________________

Operational and species info:

5) How long is your whale watching season?______________________________

6) How many times you go out everyday (on average)?______________________________

7) Roughly, what's the total number of trips that you take in a season?______________________________

10) Roughly, how many days do you skip because of bad weather in a season? ______________________________

11) What percentage of days are of rough waters or with poor visibility (under 5 miles)? (estimate)__________

8) What's the total length of your boat trip?______________________________

9) As a percentage, how much time do you spend on?

whales___________ icebergs___________ seals__________ birds____________ other?______________

12) On average, how many miles do you travel to see whales, icebergs, seals? (estimate)___________________

13) On average, how long does it take to encounter the first whale once on site?____________________________

14) What are the species that you see and when is most likely ?

Humpback	Fin (finbacks)	Minke
Pilot whales (potheads)	Killer Whales	White-sided dolphins
White-beaked dolphins	Harbour porpoise	Saddle-back (common dolphin)
Bottlenose whales	Blue	Sei

Code of Conduct

15) Are you aware of the Code of Conduct for tour boats? YES NO

16) Did you agree to follow the Code of Conduct for tour boats? YES NO Would you? YES NO

17) Do you inform the passengers of the Code of Conduct for tour boats? YES NO

18) Do you think the Code of Conduct could ensure professional standards in tour operations? YES NO IDK

19) Do you think that the Code of Conduct was of any benefit for your enterprise? YES NO IDK

20) Did you observe other operators who did not follow the Code? YES NO

21) If seen, what did you do about it?

22) Who delivers the interpretation on board?____

23) Would you be interested in tour operators' and interpreters' training workshops? YES NO

Number of operators check up

24) How many boat-based whale watching operation are in your area?____________________________________

25) Are you aware of any new tour boat operator that started in the last 3-4 years?__________________________

26) Any comment, suggestions or concern you would like to add concerning whale watching in Newfoundland ar Labrador and or the Code of Conduct?

Code of Conduct

for Operating Tour Boats in the Coastal Environment and Around the Marine Wildlife of Newfoundland & Labrad

OUR MISSION: It is our mission to provide passengers with an experience through which they can learn about, respect, care for and enjoy marine wildlife and Newfoundland Labrador's coastal environment without causing any harm to that environment or its inhabitants. We believe that when our passengers learn about and care for the ma environment, there will be a direct benefit to the creatures that live there. Human activity can sometimes have a negative impact on the environment and the animals we about. To ensure that does not occur during our tour boat operations, we have agreed to observe the following Code of Conduct.

OUR MARINE ENVIRONMENT: Newfoundland and Labrador's cold ocean gains its productivity by the instability of the water column that mixes oxygen rich and nutrient waters. Our coastal environment is dominated by the Labrador Current, a river in the ocean of cold Arctic waters that carries icebergs from Greenland. These conditions pr the primary productivity that builds the rich web of marine wildlife on which our Province depends.

OUR CONDUCT IN THE MARINE ENVIRONMENT: Our work environment is the ocean but it is home for the multitude of creatures that live there. In our operation we will strive in every way to minimize our impact on the quality of the environment while maximizing the comfort, enjoyment and satisfaction of our passengers.

- We will always operate our vessel safely in accordance with Department of Transport regulations.
- We will always operate our vessel with courtesy and we will be helpful to other vessels.
- We will operate our vessel in a manner which minimizes the release of any foreign material such as garbage, noise or pollutants
- We will be cautious within the vicinity of any fishing gear.
- When small vessels such as kayaks are present, we will ensure they will not be affected by the wake of our vessel
- We will operate our vessel in a manner which will minimize any harmful impact on the aesthetics of the marine environment.
- We will conduct an accurate and informative interpretation program on the marine environment.
- We will participate in training programs so that our staff has accurate, in-depth and up-to-date information on the marine environment and its inhabitants.
- We will report to the appropriate authorities any misconduct that is deemed to have a negative impact on the marine environment

OUR CONDUCT AROUND WHALES: Whales are important and plentiful animals in Newfoundland and Labrador's coastal environment. As it is in the observation of all wildlife behaviour, it is important to allow the whale to control any interaction. If the animal is curious, it will approach our vessel. If it is disturbed by our presence, it will move away. The key to our conduct around whales is to recognize that they are wild animals that must rest, forage, feed, socialize and complete other life processes to survive. Any activity by a vessel that disturbs or prevents animals from completing life processes represents a threat to the conservation and survival of these majestic creatures.

- Prior to whale watching tours, we will encourage realistic expectations of encounters with whales to avoid disappointing our customers and to reduce pressure from them to undertake risky vessel activities.
- We will operate our vessel in a manner that does not disturb whales. Harassment is indicated when the animal changes its behaviour because of our presence or activities. A change in behaviour is observed when whales change their swimming direction or speed, when they cease or increase specific behaviours, or when they leave an area.
- We will not operate our vessel in a manner that changes the behaviour of the whales, causes disruption to their social groups, or makes them leave and area.

To insure our vessel does not disturb the whales in water:

- When we are within 100m of whales, we will not try to get any closer to them.
- When animals are within 100 m of our vessel we will allow the animals to completely control the interaction and operate our vessel with due caution.
- We will ensure that animals are not surrounded by boats by giving way when more than two boats are within 100 m of whales.
- We will not pursue or chase whales.
- We will not operate our vessel at high speeds when whales are nearby.
- We will not cut across the paths of animals but will approach slowly from the rear, parallel to the animal's path.
- When whales are near our vessel we will reduce our speed and be aware of the noise our vessel makes underwater.
- We will take special care when mothers and calves are present to ensure that we do not separate them.
- When vessel traffic is intense and persistent near animals, we will conduct searches to find other, less disturbed animals.
- We will provide our passengers with accurate, up-to-date information about whales and inform them of their role in the marine ecosystem. We will urge them to appreciate and support the conservation of the animals and preservation of the [illegible] habitat animals require.
- We will encourage [illegible] and cooperate with researchers who examine the impact of tour boats on whales and the marine environment and who contribute to a greater understanding of marine biology.

OUR CONDUCT AROUND SEABIRD COLONIES: Seabird colonies on islands are cr habitats for reproduction. Mating, nesting, incubating and foraging to feed n hatched chicks are natural and essential life processes. Islands have been select breeding habitats because they provide freedom from disturbances. Disturb causes the birds to take flight, vocalize and circle in the area. This leaves egg chicks vulnerable to predators.

To ensure our vessel does not disturb nesting seabirds:

- We will operate our vessel at an adequate distance from the shores of colony islands;
- We will minimize any noise that can disturb the birds;
- We will operate our vessel at a speed and in a manner in which birds do not flus from nests.
- We will provide accurate information about the life histories of the birds, the habitat they require and instil care and respect for them.

OUR CONDUCT NEAR SEABIRDS ON WATER: Seabirds that are seen on the surf the ocean around colonies may be resting, foraging, feeding, courting or pre These are all critical activities that vessel presence can disrupt. If birds are repea forced to fly and are interrupted in their activities, serious biological consequ could develop.

To insure our vessel minimizes disturbances to seabirds on the water:

- We will give birds on the water as wide a berth as is practical.
- We will control the speed, noise and activities of our vessel to minimize the fli responses of the birds.

OUR CONDUCT NEAR OTHER SEA CREATURES: Giant basking sharks, the endan leatherback turtle, harp seals, harbour seals, grey seals, and ocean sunfish are in our waters. All these animals are busy pursuing a living and vessel presen behaviour can interfere with their endeavours.

In their presence, we will limit the speed and noise of our vessels. We will also c the proximity of our vessels to the animals so we will not disturb them.

OUR CONDUCT AROUND ICEBERGS: Icebergs are prominent featu Newfoundland and Labrador's coastal environment. They are ever changin beautiful as they drift in currents from Greenland past our shores. However c should be taken as these massive ice masses can break apart or rollover w notice.

To ensure our vessel and passengers are safe:

- We will give icebergs adequate berth for the safety of our vessel and passenge

USE OF THE CODE: We will provide our passengers with copies of this C Conduct, on request, so they understand the constraints on the operation vessel.

- We have formulated this Code based on our experience with the animals and marine environment and in consultation with marine mammal and seabird scientists. We are committed to providing a memorable experience for our passengers without harming the wildlife. Because there are no current guid which could evaluate and monitor correct conduct in the marine environme we will participate fully in assessing the value of this newly created Code as a method of protecting ocean wildlife. We will work to adjust the code in the fi to maintain its relevance as a practical method of ensuring a secure habitat f wildlife while continuing to provide a first rate experience for our passenger

If our passengers have complaints about our behaviour, or perceive a fai follow this code, they should discuss them with us. They can also conta Adventure Tourism Association of Newfoundland and Labrador (ATA to report and discuss their complaints.

Tel: (709) 722-2000 Fax: (709) 722-8104 Toll Free: 1-800-56

Website: www.hospitality.nf.ca

This Code of Conduct was developed by: the Adventure Tourism Association of Newfoundland & Labrador (ATANL) Hospitality Hospitality Newfoundland & Labrad

Assistance for the project was provided by: Canada the Depa[illegible]ceans (DFO), the Department of the Environment, the Whale Research Group of [illegible] of Newfoundland

Appendix D: Whale watching experience questionnaire (2001)

The Whale Research Group of Memorial University is conducting a study on the effect of whale watching activities on whales in Witless Bay and St John's Bay, Newfoundland. We are examining the effectiveness of a voluntary tour boat operator Code of Conduct in managing boat-whale interaction. Your co-operation in filling out the questionnaire is voluntary and all the information that you provide will be used for scientific research. The questionnaire is anonymous but your contribution will help scientists and tour boat operators to protect the whales. We appreciate your help in answering the following questions:

Date:____________ Researcher:_____________________

Name of whale watching company you went with:____________________________________

Time of the day you started your tour____________________finished________________

1) Was this your first whale watching experience? YES NO

2) How many times have you been whale watching? _________________________________

3) What kind of whales did you see today? How many?______________________________

4) Were you generally satisfied with your whale watching experience?
   - very dissatisfied__________
   - dissatisfied______________
   - satisfied_______________
   - very satisfied____________

5) Were you aware that there is a Code of Conduct for tour boat operators? YES NO

6) Do you think close adherence to the rules of the Code of Conduct limited the level of satisfaction of your whale watching experience? YES NO IDKN

7) Do you think your whale watching experience was educational? YES NO IDKN

8) Do you think the whales controlled the interaction with the tour boat? YES NO IDKN

9) Did you feel that the presence of the vessel influenced the behaviour of the whales?
YES NO IDKN (YES, How____)

10) In general, do you think your tour boat operator behaved in a respectful way toward the whales and the marine environment? YES NO IDKN

Appendix E: Passenger questionnaires 2002

Memorial
University of Newfoundland

Whale watching experience questionnaire (pre-trip)

The **Whale Research Group** of Memorial University is conducting a study on the effect of whale watching activities on humpback whales in Newfoundland. We are examining the effectiveness of a voluntary Code of Conduct for tour boat operator in managing boat-whale interaction. Your co-operation in filling out the questionnaire is voluntary and all the information that you provide will be used for scientific research. The questionnaire is anonymous but your contribution will help scientists and tour boat operators to protect the whales. **We appreciate your help.** (*For further information contact the Whale Research Group at the* ***1-709-737-7638*** *or send an email to* ***e94cc@mun.ca***).

Date____________ Time of the trip___________ Whale watching company_______________________

1) Age______ 2) Sex M F 3) Country of origin_____________ 4) State/province__________

5) Profession____________________________ 6) Highest education completed ___________________

7) Do you live in? urban area rural area 8) Do you live by the sea? YES NO

9) What's the reason of your trip in Newfoundland? vacation business I live here other__________

10) Is whale watching the reason for your trip in Newfoundland? YES NO PART OF IT N/A

11) How did you get to know about whale watching in Newfoundland?_________________________

12) Do you subscribe to nature magazines at home? YES NO Which ones?____________________

13) Which one of the following items you have with you? (please circle)

guide-book binoculars camera video-camera other____________

14) How many times have you been whale watching before? ______________________________

15) What species of whales do you hope to see today?_________________________________

16) Why do you want to go whale watching?_______________________________________

17) Whales are considered? (pick one) fish invertebrates mammals crustaceans krill

18) How many humpback whales live in the North Atlantic? 500 1,500 11,000 110,000 1,250,000

19) How long do humpback whales live? 10 years 20 years 50 years 100 years 150 years

20) What's unusual about noises made by humpback whales? males sing females sing echolocation

21) What's the main food of humpback whales in Newfoundland? tuna marine mammals capelin cod

22) What is the main threat to the whales?_____________23) What can you do to help?________________

24) Are you aware that there is a Code of Conduct for tour boat operators? YES NO

25) Do you think the Code is going to limit your whale watching experience? YES NO don't know

26) How close (meters or feet) will you be to the whales?__________

THANKS FOR YOUR CO-OPERATION

Memorial University of Newfoundland

Whale watching experience questionnaire (post-trip) (2002)

The **Whale Research Group** of Memorial University is conducting a study on the effect of whale watching activities on humpback whales in Newfoundland. We are examining the effectiveness of a voluntary Code of Conduct for tour boat operator in managing boat-whale interaction. Your co-operation in filling out the questionnaire is voluntary and all the information that you provide will be used for scientific research. The questionnaire is anonymous but your contribution will help scientists and tour boat operators to protect the whales. **We appreciate your help.** (*For further information contact the Whale Research Group at the 1-709-737-7638 or send an email to e94cc@mun.ca).*

Date_____________ Time of the trip___________ Whale watching company_____________________

1) Age______ 2) Sex M F 3) Country of origin_____________ 4) State/province__________

5) Profession________________________ 6) Highest education completed _______________

7) Do you live in? urban area rural area 8) Do you live by the sea? YES NO

9) What's the reason of your trip in Newfoundland? vacation business I live here other__________

10) Is whale watching the reason for your trip in Newfoundland? YES NO PART OF IT N/A

11) How did you get to know about whale watching in Newfoundland?______________________________

12) Do you subscribe to nature magazines at home? YES NO Which ones?____________________

13) Which one of the following items you have with you? (please circle)

guide-book binoculars camera video-camera other____________

14) How many times have you been whale watching before? ______________________________

15) What species of whales did you see today? How many?______________________________

16) Why did you want to go whale watching?____________________________________

17) Whales are considered? (pick one) fish invertebrates mammals crustaceans krill

18) How many humpback whales live in the North Atlantic? 500 1,500 11,000 110,000 1,250,000

19) How long do humpback whales live? 10 years 20 years 50 years 100 years 150 years

20) What's unusual about noises made by humpback whales? males sing females sing echolocation

21) What's the main food of humpback whales in Newfoundland? tuna marine mammals capelin cod

22) What is the main threat to the whales?______________ 23) What can you do to help?______________

24) Are you aware that there is a Code of Conduct for tour boat operators? YES NO

25) Do you think the Code limited your whale watching experience? YES NO don't know

26) How close (in meters or feet) were you to the whales?_______________

PLEASE SEE REVERSE →

27) Were you generally satisfied with your whale watching experience? (circle one)

a) very dissatisfied   b) dissatisfied   c) satisfied   d) very satisfied

28) What do you think contributed the most to the satisfaction of your boat tour?

Please assign a grade of importance to each of the following categories:

	IMPORTANCE				
	not important	slightly important	important	very important	extremely important
seeing the whales					
getting close to the whales					
adherence to the Code					
seeing the seals					
seeing the birds					
seeing the icebergs					
scenery					
weather					
information available					
naturalist guide					
boat ride					
comfort of the boat					
music					
entertainment					
refreshments on board					

29) Were your expectations fulfilled?   YES   NO   (if NO, why not?________________________________)

30) Did the tour boat operator perform any of the following actions?

	YES	NO
Getting on purpose closer than 100 m to a whale?		
Approaching a whale when already engaged by two other vessels?		
Pursuing or chasing a whale?		
Not reducing speed when the whale was within 100 m?		
Approaching a whale directly from the front or from the side?		

31) Do you think your tour boat operator followed the rules of the Code of Conduct?   YES   NO   can't tell

32) Do you think the whales controlled the interaction with the tour boat?   YES   NO   can't tell

33) If you witnessed infractions to the Code of Conduct, would you report them to the authorities?

YES   NO   not sure

34) Who would you report the infractions to?________________________________

35) Did you feel that the presence of the vessel influenced the behaviour of the whales?

YES   NO   not sure   (if YES, How?________________________________)

36) In general, do you think your tour boat operator behaved in a respectful way toward the whales and the marine environment?   YES   NO   don't know

THANKS FOR YOUR CO-OPERATION

Appendix F: Passenger questionnaires 2003

Memorial
University of Newfoundland

Whale watching experience questionnaire (pre-trip)

The **Whale Research Group** of Memorial University is conducting a study on the effect of whale watching activities on humpback whales in Newfoundland. We are examining the effectiveness of a voluntary Code of Conduct for tour boat operator in managing boat-whale interaction. Your co-operation in filling out the questionnaire is voluntary and all the information that you provide will be used for scientific research. The questionnaire is anonymous but your contribution will help scientists and tour boat operators to protect the whales. **We appreciate your help.** (*For further information contact the Whale Research Group at the **1-709-737-7638** or send an email to **e94cc@mun.ca**).*

Date_____________ Time of the trip____________ Whale watching company you are going with______________

1) Age_______ 2) Sex M F 3) Country of origin______________ 4) State/province____________

5) Profession________________________________ 6) Highest education completed _________________________

7) Do you subscribe to nature magazines at home? YES NO

8) Which one of the following items you have with you? (please circle)

guide-book binoculars camera video-camera other________________

9) How many times have you been whale watching before? ____

10) What species of whales do you hope to see today?____

11) What makes whales different from fish?____

12) How many humpback whales live in the North Atlantic? ____

13) How long do humpback whales live?____

14) What do humpback whales use for communication?____

15) What's the main food of humpback whales in Newfoundland?____

16) Are humpback whales endangered? _____________ 17) How close will you be to the whales?______(m/ft)

18) What are the main threats to humpback whales?____

19) Do you foresee any solutions?____

20) Are you aware that there is a Code of Conduct for tour boat operators? YES NO

21) Are you involved in environmental conservation? YES NO 22) How?______________________________

23) Do you see yourself more involved in environmental conservation in the near future? YES NO I don't know

If YES What will you do?____

24) In the future would you agree to pay $2 on top of your ticket as a donation to whale research? YES NO

THANKS FOR YOUR CO-OPERATION

Memorial
University of Newfoundland

Whale watching experience questionnaire (post-trip)

The **Whale Research Group** of Memorial University is conducting a study on the effect of whale watching activities on humpback whales in Newfoundland. We are examining the effectiveness of a voluntary Code of Conduct for tour boat operator in managing boat-whale interaction. Your co-operation in filling out the questionnaire is voluntary and all the information that you provide will be used for scientific research. The questionnaire is anonymous but your contribution will help scientists and tour boat operators to protect the whales. **We appreciate your help.** (*For further information contact the Whale Research Group at the 1-709-737-7638 or send an email to e94cc@mun.ca*).

Date____________ Time of the trip____________ Whale watching company you went with__________________

1) Age______ 2) Sex M F 3) Country of origin______________ 4) State/province____________

5) Profession______________________________ 6) Highest education completed __________________

7) Do you subscribe to nature magazines at home? YES NO

8) Which one of the following items you have with you? (please circle)

guide-book binoculars camera video-camera other______________

9) How many times have you been whale watching before? ____________________________________

10) What species of whales did you see today? How many?____________________________________

11) What makes whales different from fish?____

12) How many humpback whales live in the North Atlantic?____________________________________

13) How long do humpback whales live?____

14) What do humpback whales use for communication?_______________________________________

15) What's the main food of humpback whales in Newfoundland?________________________________

16) Are humpback whales endangered? ______________ 17) How close were you to the whales?__________(m/ft)

18) What are the main threats to the whales?____

19) Do you foresee any solutions?____

20) Are you aware that there is a Code of Conduct for tour boat operators? YES NO

21) Are you involved in environmental conservation? YES NO 22) How?______________________________

23) Do you see yourself more involved in environmental conservation in the near future? YES NO I don't know

If YES What will you do?____

24) In the future would you agree to pay $2 on top of your ticket as a donation to whale research? YES NO

PLEASE SEE REVERSE →

25) Did the tour boat operator perform any of the following actions?

	YES	NO
Getting *on purpose* closer than 100 m to a whale?		
Approaching a whale when already engaged by two other vessels?		
Pursuing or chasing a whale?		
Not reducing speed when the whale was within 100 m?		
Approaching a whale directly from the front or from the side?		

26) Do you think your tour boat operator followed the rules of the Code of Conduct? YES NO can't tell

27) Do you know what the rules of the Code of Conduct are? YES NO

28) If you witnessed infractions to the Code of Conduct, would you report them to the authorities?

YES NO not sure

29) Who would you report the infractions to?____________________________________

THANKS FOR YOUR CO-OPERATION

Appendix G: Passenger questionnaires 2004

Memorial University of Newfoundland

Whale watching questionnaire (pre-trip)

The **Whale Research Group** of Memorial University is conducting a study, on the effect of whale watching activities on humpback whales in Newfoundland. We are examining the effectiveness of a voluntary Code of Conduct for tour boat operator in managing boat-whale interaction. Your co-operation in filling out the questionnaire is voluntary and all the information that you provide will be used for scientific research. The questionnaire is anonymous but your contribution will help scientists and tour boat operators to protect the whales. **We appreciate your help**. (*For further information contact the Whale Research Group at the* ***1-709-737-7638*** *or send an email to* ***e94cc@mun.ca****)*.

Exp Group 1 2 video/talk

Date______________ Time of the trip____________ Whale watching company you are going with_______________

1) Age_______ 2) Sex M F 3) Country of origin_______________ 4) State/province____________

5) Profession____________________________ 6) Highest education completed ___________________________

7) Do you subscribe to nature magazines at home? YES NO

8) Which one of the following items you have with you? (please circle)

guide-book binoculars camera video-camera other______________

9) How many times have you been whale watching before? ____

10) What species of whales do you hope to see today?____

11) What makes whales different from fish?____

12) Why do humpback whales come to northern colder waters?____

13) Why do humpback whale populations grow slowly?____

14) What do humpback whales use for communication?____

15) What is the closest distance tour boat operators can approach the whales?_________________(m)

16) How many tour boats can approach a whale at once?____

17) What is the best way to approach a whale? from the front from the side parallel from behind

18) Are you aware that there is a Code of Conduct for tour boat operators? YES NO

19) If you witnessed infractions to the code, would you report them to the authorities? YES NO not sure

20) Who would you report the infractions to?____

21) Are you involved in environmental conservation? YES NO 22) How?__________________________

23) Do you see yourself more involved in environmental conservation in the near future? YES NO I don't know

If yes, what will you do?____

THANKS FOR YOUR CO-OPERATION

Memorial
University of Newfoundland

The **Whale Research Group** of Memorial University is conducting a study on the effect of whale watching activities on humpback whales in Newfoundland. We are examining the effectiveness of a voluntary Code of Conduct for tour boat operator in managing boat-whale interaction. Your co-operation in filling out the questionnaire is voluntary and all the information that you provide will be used for scientific research. The questionnaire is anonymous but your contribution will help scientists and tour boat operators to protect the whales. **We appreciate your help.** (*For further information contact the Whale Research Group at the 1-709-737-7638 or send an email to e94cc@mun.ca).*

Exp Group 3 4 video/talk

Date____________ Time of the trip___________ Whale watching company you went with___________________

1) Age______ 2) Sex M F 3) Country of origin_____________ 4) State/province_______________

5) Profession_____________________________ 6) Highest education completed __________________

7) Do you subscribe to nature magazines at home? YES NO

8) Which one of the following items you have with you? (please circle)

guide-book binoculars camera video-camera other______________

9) How many times have you been whale watching before? ______________________________________

10) What species of whales did you see today?____

11) What makes whales different from fish?____

12) Why do humpback whales come to northern colder waters?__________________________________

13) Why do humpback whale populations grow slowly?____

14) What do humpback whales use for communication?______________________________________

15) What is the closest distance tour boat operators can approach the whales?_______________(m)

16) How many tour boats can approach a whale at once?_____________________________________

17) What is the best way to approach a whale? from the front from the side parallel from behind

18) Are you aware that there is a Code of Conduct for tour boat operators? YES NO

19) If you witnessed infractions to the code, would you report them to the authorities? YES NO not sure

20) Who would you report the infractions to?____

21) Are you involved in environmental conservation? YES NO 22) How?__________________________

23) Do you see yourself more involved in environmental conservation in the near future? YES NO I don't know

If yes, what will you do?____

PLEASE SEE REVERSE →

24) How close were you to the whales?____________________(m)

25) Did the tour boat operator perform any of the following actions?

	YES	NO
Getting *on purpose* closer than 100 m to a whale?		
Approaching a whale when already engaged by two other vessels?		
Pursuing or chasing a whale?		
Not reducing speed when the whale was within 100 m?		
Approaching a whale directly from the front or from the side?		

25) Do you think your tour boat operator followed the rules of the Code of Conduct? YES NO can't tell

THANKS FOR YOUR CO-OPERATION