

Proposal to Monitor Tourism and Recreational Use and the Power  
of Educational Programs to Protect Wildlife in the Tofino Mudflats  
Wildlife Management Area

Submitted to the Clayoquot Biosphere Trust, Habitat Conservation Trust  
Fund and the Raincoast Education Society

Barbara Beasley, Ph.D.  
March 2007

Funding to write the proposal was generously provided by the Habitat Conservation Trust Fund. Dr. Pamela Wright of UNBC, the Clayoquot Biosphere Trust and numerous community members and organizations, listed at the end of the report, contributed in kind support.

## Table of Contents

1. Executive Summary .....	3
2. Introduction.....	4
3. Background on the Mudflats.....	5
3.1 Ecological significance.....	5
3.2 WMA designation and the Management Plan .....	6
4. How much tourism and recreational use currently occurs in the WMA? .....	8
4.1 Issue.....	8
4.2 Background .....	8
4.3 Potential Monitoring Approach.....	9
4.4 Potential Partners .....	11
4.5 Budget Estimate * .....	12
5. What effect do tourism and recreational activities have on wildlife habitat and wildlife?.....	12
5.1 Issue.....	12
5.2 Background .....	13
5.2.1 Effects of shore walkers on birds.....	14
5.2.2 Effects of boats on birds.....	14
5.2.3 Effects of aircraft noise on birds.....	15
5.2.4 Crowding Displacement from the Big Tree Trail on Meares Island .....	15
5.2.5 Effects of Trampling and Digging in the Intertidal Mudflats.....	15
5.2.6 Effects of Water Pollution on Eelgrass .....	16
5.3 Potential Approaches for Monitoring.....	17
5.3.1 Effects of shore walkers, boat and aircraft on birds.....	17
5.3.2 Crowding Displacement from the Big Tree Trail on Meares Island .....	18
5.3.3 Trampling and Digging in the Intertidal Mudflats.....	18
5.3.4 Water Pollution Effects on Eelgrass .....	19
5.4 Potential Partners .....	19
5.5 Budget Estimate .....	19
6. How can we address negative impacts through education and stewardship programs/materials in a cost-effective way? .....	20
6.1 Issue.....	20
6.2 Background .....	20
6.3 Potential Monitoring Approach at Chesterman Beach.....	21
6.4 Partners.....	22
6.5 Budget Estimate .....	22
7. Can we plan for (inevitable) future expansion of tourism and recreational use so that it will occur in a controlled, well-managed way at particular locations and, as such, have minimal impact?.....	22
7.1 The Issue .....	22
7.2 Background .....	23
7.3 Proposed Approach.....	23
7.4 Potential Partners .....	23
7.5 Budget Estimate .....	23
8. Personal Communications.....	23
9. Literature Cited.....	25
10. Appendix A. ....	29
11. Appendix B. ....	30
12. Appendix C. ....	31

## **1. Executive Summary**

The Tofino Mudflats Wildlife Management Area (WMA), 1770 hectares of tidal flats and 338 hectares of forested land, is considered one of the ten most critical wetland areas for migratory birds on Canada's West Coast. It lies within the traditional territory of the Tlao-qui-aht First Nations and is bordered by private residential, municipal, commercial and National Park properties. Visitor surveys indicate that Tofino is visited by close to 1 million people each year and the main recreational activities of visitors are hiking/walking and wildlife/bird watching (Tourism Association of Vancouver Island 2003). Currently, very few people visit the WMA, however, as Tofino continues to grow, recreational use is expected to increase. This could lead to disturbances to migrating waterbirds, a greater risk of negative interactions between humans and wildlife, and environmental degradation. The management plan for the Tofino Mudflats WMA calls for stewardship and educational activities that will increase awareness and mitigate problems associated with increased human activity within and around the Tofino Mudflats. In 2004, the Raincoast Education Society (RES) began implementing a series of educational activities to promote awareness of the critical wildlife habitat within the Tofino Mudflats, build stewardship skills and create enthusiasm and commitment among local residents and groups for conserving the ecological integrity of the WMA. To date, the abundance and distribution of some resources within the WMA (e.g., water birds and eelgrass beds) have been monitored but not the level of recreational use or its effects. This proposal provides a community-based monitoring framework for addressing the following questions: How much tourism and recreational use currently occurs in the WMA?; what effect do tourism and recreational activities have on wildlife habitat and wildlife?; how can we address negative impacts through education and stewardship programs in a cost-effective way?; and can we plan for (inevitable) future expansion of tourism and recreational use so that it will occur in a controlled, well-managed way at particular locations and, as such, have minimal impact? Approaches for answering each of these questions are proposed along with partners and budget estimates. Fine-tuning of the monitoring approaches and budget should be expected as academic partners and interested community members/stakeholders become involved.

## 2. Introduction

The purpose of this document is to propose a community-based program to monitor tourism and recreational use and evaluate the effectiveness of educational programs to protect wildlife on the Tofino Mudflats Wildlife Management Area (WMA). The Tofino Mudflats WMA, located near the village of Tofino on the west coast of Vancouver Island (49° 08'N, 125° 52'W), is an area protected under the jurisdiction of the B.C. Ministry of Environment. The WMA was formed to ensure that critical wetland habitats for migratory birds, ecologically important eelgrass beds, and other habitats, are not compromised by development or over-use. Visitor surveys indicate that Tofino is visited by close to 1 million people each year and the main recreational activities of visitors are hiking/walking and wildlife/bird watching (Tourism Association of Vancouver Island 2003). Although low levels of tourism and recreational use were identified in the Management Plan for the WMA (Eggen et al. 2002), increases in recreational use are expected as the population of Tofino expands and development proceeds adjacent to the WMA. There are concerns that increased tourism and recreational use will disrupt wildlife and habitats within the WMA.

Currently there are no quantitative baseline data on how much tourism and recreational use currently occurs in the WMA, or what effect these activities have on wildlife habitat and wildlife. Baseline information is needed to decide on management approaches that will do the following: minimize negative impacts of recreational use through education and stewardship programs in a cost-effective way, and plan for (inevitable) future expansion of tourism and recreational use so that it will occur in a controlled, well-managed way at particular locations and, as such, have minimal impact.

This proposal focuses on developing a community-based monitoring program with academic partners to address these questions. Being community-based is important because our ultimate goal is to provide stewardship of the Tofino Mudflats WMA over the long term. We expect that community members can be involved in ways that will build information and local capacity for holistic decision-making and be cost-effective over the long-term.

*“Monitoring is a first step toward taking responsibility for the condition of one’s home, community or ecosystem. This theme of accountability-of individuals, communities, and governments-pervades discussions of monitoring and ecosystem management.”* Bliss et al. 2001.

This proposal is also an invitation to academic partners to contribute expertise and resources in developing appropriate methodologies, collecting specific types of data, analyzing trends and making the results useful for decision-making. The WMA is within the Clayoquot Biosphere Reserve whose mandate is to support research, monitoring and sustainable development. Lessons learned through involvement in the community-based

monitoring program and its results may be generalized to other situations and locations throughout the world. Thus, an invitation to participate offers a valuable opportunity for academia to contribute to societal needs while conducting research.

The first section of the proposal presents a summary of background information on the Tofino Mudflats, their ecological significance, the WMA designation and the Management Plan. Section 4 describes an approach for collecting baseline information on recreational and tourism use in the WMA in a way that involves local ecotour operators and residents. Section 5 summarizes possible threats (real and potential) to wildlife and wildlife habitats in the WMA from tourism/recreational use. I highlight the threats/issues raised through interviews with community members and eco-tourism businesses. For each issue, I summarize key literature relevant to the impacts of tourism on wildlife and propose that local guides and residents be trained to quantify the frequency of human-wildlife interactions and wildlife responses. Section 6 considers ways of measuring the effectiveness of an education and stewardship program designed to reduce the impacts of recreation on migrating shorebirds at Chesterman Beach. The final section of the proposal considers the need for a decision-making framework for managers who are responsible for limiting or facilitating recreational use of the WMA. It suggests that an overall mechanism for bringing information from monitoring into a holistic framework would be helpful for the Tofino Mudflats WMA Advisory Committee and the B.C. Ministry of Environment.

A budget estimate for each of the deliverables is presented at the end of each section. Fine-tuning of the monitoring approaches and budget should be expected as academic partners and interested community members/stakeholders become involved.

### **3. Background on the Mudflats**

#### ***3.1 Ecological significance***

The Tofino Mudflats Wildlife Management Area (WMA), 1770 hectares of tidal flats and 338 hectares of forested land are part of the Estevan Coastal Plain (1.5 to 3 km wide) lying along the west coast of Vancouver Island. The plain is comprised of glacial till with scattered hummocks and bluffs that reach up to 100m in elevation. An average rainfall of 3 m each year drains into the mudflats, bringing terrestrial nutrients that mix with marine nutrients brought in on ocean tidal flows. These nutrients enrich the tidal channels, eelgrass beds and small estuarine marshes that make up the mudflats (Figure 1).

The Tofino Mudflats contain the largest eelgrass beds on the west coast of Vancouver Island and are second only to the Fraser River delta in importance as feeding and resting sites for Western Sandpipers in British Columbia (Butler et al. 1992). Eelgrass roots and stems bind and stabilize the mud, and the plant provides food and habitat for commercially important fish, crabs and other invertebrates, as well as birds. Butler et al. (1992) found that the eelgrass beds in the Tofino Mudflats support high water bird densities (434 to 6690 birds/km<sup>2</sup>). Each year, the mudflats provide habitat for 33,000 ducks and geese in winter, and 100,000 Western Sandpipers and 44 other species of

shorebirds en route to and from the arctic breeding grounds in spring and summer. The Tofino Mudflats have been designated as an Important Bird Area of Canada and nominated as a Western Hemisphere Shorebird Reserve and RAMSAR site.

### **3.2 WMA designation and the Management Plan**

The Province of British Columbia recognized the ecological significance of the Tofino Mudflats over 50 years ago. In the early 1950s, the Provincial Museum and the B.C. Game Department documented the waterfowl resources in the Tofino area to determine its suitability as a “public shooting ground”. The first formal protection took place in 1956 when several parcels of land were designated as reserves for “Use, Recreation and Enjoyment of the Public”.

In 1993, the Pacific Estuary Conservation Program recommended that the Tofino Mudflats become the top priority on Vancouver Island for the development of a Wildlife Management Area (WMA). A proposal was drafted and referred to 15 agencies, public groups, First Nations, and the Clayoquot Sound Central Region Board (CRB). In 1997, the Tofino Mudflats were officially designated as a Wildlife Management Area.

A Management Plan for the Tofino Mudflats Wildlife Management Area (WMA) was developed in 2001 (Eggen et al. 2001). It provided a description of the ecology and human use at the time, developed a strategy to protect the natural resources of the WMA and initiated a plan for a wildlife-viewing network. The BC Ministry of Environment is the administrative authority of the WMA. They work closely with the local WMA Advisory Committee made up of representatives from other agencies (Parks Canada), local governments (District of Tofino), non-profit groups (Clayoquot Biosphere Trust, Raincoast Education Society, Tofino Botanical Garden Foundation, Tofino Streamkeepers), and other interested groups (Tofino Chamber of Commerce, Pacific Rim Fish and Game Association and others).

The Management Plan recommended several management objectives for the WMA:

- Increase awareness and education about the WMA.
- Encourage the development of community stewardship programs.
- Collect ecological data and species inventories within the WMA.
- Prohibit developmental plans and other activities, which are detrimental to sensitive fish and wildlife habitats.
- Collaborate with municipal, First Nations, regional and federal government agencies in improving environmental conditions beyond the WMA boundaries.



Figure 1. The Tofino Mudflats WMA are comprised of five mudflat areas known locally as Arakan Flats, Ducking Flats, Doug Banks' Flats, Maltby Slough, and South Bay. Grice Bay, to the south east is protected within Pacific Rim National Park Reserve of Canada. Chesterman Beach is a wave-washed, sand beach with tangles of driftwood along the upper tide line, across from the Doug Banks' Flats on the northwest side of the Esowista Peninsula.

In 2004, the Raincoast Education Society (RES), with support from members of the WMA Advisory Committee, began implementing a series of educational activities to promote awareness of the critical wildlife habitat within the Tofino Mudflats, build stewardship skills and create enthusiasm and commitment among local residents and groups for conserving the ecological integrity of the WMA. At the same time, the Clayoquot Biosphere Trust reviewed inventory and monitoring activities and identified gaps in information about the level of recreational use and its effects (Olive 2005). As a result, the RES and CBT are partnered in developing this proposal. Our goal is to design a monitoring program that will determine how much recreational use does occur, and could occur, on the Tofino Mudflats without negative effect, and to evaluate the effectiveness of the RES's educational/stewardship programs.

#### **4. How much tourism and recreational use currently occurs in the WMA?**

##### **4.1 Issue**

Measurements of tourism and recreational use of the Tofino Mudflats would provide useful baseline information for planning and management of the WMA. Wildlife, resource levels and ecological integrity are impacted depending on levels of human use. Information about the timing and dispersion of visitor use will help determine target audiences for educational materials and effective management techniques for minimizing impacts.

##### **4.2 Background**

Recreational and tourist activities on the Tofino Mudflats include kayaking/canoeing, bird and wildlife watching, site seeing, hunting, sport fishing, and clam and crab harvesting. Interviews with a few tour operators indicate that use is dispersed and mainly occurs in the summer (Table 1). Eggen et al. (2002) reported that a large majority of the WMA is not highly used by people. The eco-tour operators that I interviewed confirmed that water access to most of the WMA is restricted to high tide periods and, then is limited by shallow water. There are only a few public shoreline access points because most of the WMA is adjacent to private property.

**Table 1. Ecotourism activities in and around the Tofino Mudflats WMA based on interviews in the winter of 2006/07.**

Use	Frequency *	Time of Year/Tide	Location
Birding Tours	Daily – estimate 500 visitors per season	Late May to September / close to high tide	Doug Banks Flats
Naturalist Tours - exploring mudflats on foot, includes digging	Twice weekly - estimate 2000 visitors per summer.	Summer / low tide	Shoreline adjacent to Doug Banks Flats)
Kayaking/Canoeing Tours	Once a week in shoulder season; Daily during peak- estimate 2000 visitors per summer.	March to October / high to mid tide	Arakun Flats and Ducking Flats; often en route to Big Tree Trail on Meares Isle.
Hunting waterfowl	Infrequently – no estimate available	October to January	Ducking Flats primarily
Walking, dog walking	Irregularly – no estimate available	Year round	Yellow-gate Trail on Esowista Peninsula
Sight seeing flights by aircraft	Irregularly as intentional flights to see the Mudflats but other flights occur several times each day.	Year round	Arakun Flats primarily
Clam harvesting	Infrequent – no estimate available	Year round / low tide	Arakun Islands, Mikes Islands
Crab harvesting	Daily – no estimate available	Year round / high tide	Adjacent to (but not within) eelgrass beds.
Sport fishing	Daily in peak season in deeper waters adjacent to the Tofino Flats – no estimate available.	April to October	Browning Passage, outside the Tofino Mudflats.

\* Frequency is likely underestimated as it is based on interviews with only a portion of the operators.

### ***4.3 Potential Monitoring Approach***

There are numerous techniques that can be used to estimate visitor use (Watson et al. 2000). The most appropriate technique is one that can provide a sufficient level of accuracy for management needs, while keeping monitoring costs affordable and minimizing the time required for visitors and operators to supply information (P. Wright pers. comm.). The Tofino Mudflats WMA covers an extensive area with numerous access points. Background information indicates that use is dispersed geographically and over time. Thus, it is not possible to collect information about human use from a single point or with a single technique. Instead, I propose that measurements about the number of visitors/recreational users over time periods, and type of use (e.g., where, when, how they use the WMA) should be collected using four methods:

- Standardized reporting card for ecotour operators, followed by interviews

- mid-way and at the end of the season to review the accuracy of the data.
- Standardized reporting forms and interviews with residents living along the Tofino Mudflats.
- Direct observation by trained personnel and volunteers at high use access points during sensitive time periods for shorebird migration.
- Trail counter at the Yellow Gate trail.

Tour companies guide most of the visitors who use the Tofino Mudflats. The proposed report card is modified from one used in the Jasper River Study (Wright 1996) (Appendix A). It includes space to record observations of wildlife and their responses to trips to promote a sense of stewardship, as explained in the next section (5.3). Wright (1996) found that companies often neglected to fill in and submit data forms to researchers. The follow-up interview is meant to clarify information provided on the form and fill in any blanks. It would also provide an opportunity to encourage the continued participation of the guides. A reward (gift certificate or book about natural history) should be used to provide greater incentive for accurate record keeping.

Interviews with residents, and submitted observations, would provide a qualitative description of the frequency of human use in some remote (and inaccessible) parts of the WMA, where use is expected to be very low. Asking residents to report their observations of human use and wildlife would provide a tangible way of involving residents in stewardship. An option to train residents to enter observations on-line to the West Coast Aquatic Management Board Web Atlas ([www.westcoastaquatic.ca/RIS.htm](http://www.westcoastaquatic.ca/RIS.htm)) could also be pursued (C. Olive, pers. comm.). The Web Atlas is currently under development.

The primary public access points to the Mudflats for birders during the shorebird migration is at Sharp Rd, the Tofino Botanical Gardens, and by boating across the Tofino Harbour to Lemmens Inlet. A trained observer could sample the number of users (and length of time spent) at Sharp Road and the Tofino Botanical Gardens during one to two hour blocks of time, before and after high tide (i.e., the best time for birding). Similarly, a trained observer could observe kayakers crossing to Lemmens Inlet from Tofino while counting the number of aircraft and motor boats, traveling over or close to the WMA, from a vantage point along Main Street in Tofino. I expect this could be an unexciting task. Two-hour blocks that coincide with ecotour company schedules during migration periods (mid-April to the end of May and July to September) are recommended.

A trail counter installed within the WMA on the trail beyond the Yellow Gate (District Lots 271-272) would provide an accurate count of the number of people walking that part of the WMA. At this time, there is no information about the frequency of use in that terrestrial portion of the WMA.

#### **4.4 Potential Partners**

The following eco-tour operators, interviewed in the winter of 2006/07 stated a willingness to provide or help collect data on the frequency of tours they lead to the Tofino Mudflats, as time permits.

- George Bradd, Just Birding. George takes birders to visit the mudflats daily from late May to September. Approximately 20% of his business relies on the Mudflats.
- George Patterson/Josie Osborne/John Platenius, Tofino Botanical Gardens Foundation and Clayoquot Field Station. Visitors to the TBG have access to a trail system that leads to the WMA and portions of the Tofino Mudflats north of the WMA boundary throughout the year. In summer, the TBGF offers guided tours of the mudflats twice weekly.
- Tom Stere, Tofino Sea Kayaking. Tofino Sea Kayaking offers guided tours to Arakun Flats, usually at high tide. They also rent kayaks to independent paddlers who often visit the WMA. In summer, they use the area 1-3 times daily.
- Don Travers/Kati Martini, Remote Passages. Remote Passages guides tours to the Arakun Flats and Ducking Flats when they have clients who are keen birders (infrequently) or when they see bears foraging along shore. They paddle outside and past the WMA daily throughout the spring and summer.
- Giselle Martin, Tla-ook Adventures. Tla-ook Adventures paddle their dugout canoes to Lemmens Inlet once or twice daily during the summer. If time permits, they explore Arakun Flats when the tide is high.

The Raincoast Education Society plans to conduct interviews with local residents as part of the Mudflats Stewardship Program being funded by the Habitat Conservation Trust Fund. The RES will deliver “Welcome Wagon” style information packages about the WMA during the summers of 2007 and 2008.

Possible sources for funding/personnel to conduct direct observations of human use include the B.C. Conservation Corps, Katimavik, and visiting students from universities that are willing to engage in community-based research (e.g., Environmental Studies and Geography from the University of Victoria have offered field courses in community-based research in Tofino and Ucluelet since 2004).

The Clayoquot Biosphere Trust can provide office facilities (desk, computer, fax and phone line) for a coordination and data entry by monitoring personnel in the Tofino office. Rebecca Vines, Research Coordinator for the CBT, is willing to provide advice and coaching for those hired to conduct interviews.

Wardens and researchers from Pacific Rim National Park Reserve may be willing to help monitor the trail counter at the Yellow Gate trail. The information might be useful as part of their program to monitor human-wildlife interactions (B. Hansen, pers. comm.).

#### **4.5 Budget Estimate \***

Personnel	Description		Cost
Coordinator	Hiring, training staff and volunteers, scheduling, oversee data collection, data analyses, report writing	April – Nov. 3/4 time (@200/day)	\$24,000
Senior Research Assistant	Interviews, observations, data entry	May – Sept. Full time (@150/day)	\$15,000
Junior Research Assistant	Interviews, observations, data entry	May – Sept. Full time (@100/day)	\$10,000
Supplies	Field forms, rain-proof notebooks,		\$1000
Equipment	Binoculars, spotting scope Trail counter		\$2500
Administration	Office space, computer, phone, fax, overhead		In Kind
TOTAL			\$52,500

\* Estimate depends on \$25,000 from HCTF and other funds for RES to deliver Mudflat stewardship activities in 2007-09.

## **5. What effect do tourism and recreational activities have on wildlife habitat and wildlife?**

### **5.1 Issue**

Tourism and recreation can produce negative impacts on the natural environment through a wide variety of mechanisms at a wide variety of scales. These range from a single minimal-impact kayaking trip, to intensive tourist accommodation and residential development immediately around the borders of protected areas (Buckley 2004).

Development commonly increases the number of fences which act as barriers to wildlife movements, the number of dogs and cats which prey on native birds and wildlife, cars and noise which kill and disturb native birds and animals, and the introduction of garden plants and weeds which may also disperse into protected areas (Buckley 2004). Improper garbage disposal can lead to the habituation of bears and wolves and ultimately pose a safety risk, cause property damage and lead to the destruction of wildlife. The impacts of

development are the primary concern for the Tofino Mudflats WMA Advisory Committee and B.C. Ministry of Environment (T. Reid, pers. comm.), however, there is also an interest in understanding how human use affects the remote wilderness areas of the WMA. Information about wildlife responses to recreational use would be helpful in determining how to reduce negative effects through education (e.g., teaching minimal impact practices) and management (e.g., restricting the use of sensitive areas).

## **5.2 Background**

As a means of updating information about the potential impacts of tourism and recreational use at the Tofino Mudflats in 2006, I interviewed several local people who use and/or have a stake in stewardship of the Mudflats. The interviewees included four local ecotourism operators (who run kayak, cultural/dug-out canoe, and bird tours), two landowners who live adjacent to the WMA, the director of the Tofino Streamkeepers Society, a commercial floatplane pilot who operates in Tofino Harbour, the director of the Tofino Botanical Gardens Foundation which conducts educational naturalist programs on the Mudflats, the manager of the Tofino Chamber of Commerce, the director of Parks and Recreation for the Municipality of Tofino, a member of the Tla-o-qui-aht First Nation who has gathered resources from the area for over 50 years, two senior wardens and a research biologist with Pacific Rim National Park Reserve, and a local geographer who has been involved in mapping habitat features and wildlife use of the WMA since 2005. All the interviewees had resided in Tofino for a minimum of 5 years. All were aware of the development & tourism pressures in the area. I asked each person about the effects of tourism/recreational use that they had observed or expected to see.

Similar threats to those described in the Management Plan (Eggen et al. 2002) were identified as having a potential impact on wildlife of the WMA:

- free-roaming dogs and beach walkers disturbing shorebirds, primarily at Chestermans Beach;
- boat traffic, including speedboats, canoes and kayaks, potentially disturbing birds and wildlife on various parts of the mudflats;
- air traffic disturbing birds and wildlife on Arakun Flats;
- crowding displacement to other sites in the WMA, such as Arakun Flats, from the Big Tree Trail;
- trampling and digging intertidal areas of the mudflats on naturalist tours; and
- water pollution, especially raw sewage, causing the deterioration of eelgrass beds.

Hunting and clam-digging were considered to have little effect because these activities, appear to occur very infrequently. Crab traps are set throughout the Mudflats and appear to be carefully placed outside of eelgrass beds.

I reviewed the scientific literature and ongoing research activities in the region to decide

how to develop a monitoring approach relevant to each of these issues. The following summarizes my findings.

### 5.2.1 Effects of shore walkers on birds

Over 300 published papers record negative impacts of ecotourism, recreation and associated human disturbance on birds (Hockin 1992 in Buckley 2004). For migrating and overwintering birds, even a low frequency disturbance reduces feeding time significantly, and, in combination with the energetic costs of flushing (flying off when disturbed), can tip the birds over the threshold from survival to starvation and death (Buckley 2004). For example, golden plovers alarmed by walkers were shown to spend an extra hour a day foraging for food (Yalden and Yalden 1990), piping plovers lost more than 50% of their normal feeding time (Burger 1994) and semipalmated sandpipers lost 68% of their foraging time, decreasing their fat reserves so much that they could not survive the winter (Shepherd and Boates 1999).

Many bird species flush more readily and at greater distances from people with dogs, than from unaccompanied walkers (Yalden and Yalden 1989, 1990, Burger and Galli 1980) and more readily from joggers than slow walkers, and large groups than individuals (Burger 1981). Complete avoidance of areas used by tourists has been recorded for common sandpipers (Yalden and Yalden 1980), piping plovers (Burger 1994) and various ducks (Tuite et al. 1983, 1984). During the busiest tourist periods, wintering sanderlings could not be found on Florida beaches during the day; they fed only at night (Burger and Gochfeld 1991).

### 5.2.2 Effects of boats on birds

Noise, speed and suddenness are factors in determining bird responses to boats. Rapid unpredictable movements appear to pose the greatest disturbance (Knight and Cole 1995) although cumulative disturbance by slow, predictable activities can also flush birds. For example, ducks, geese and swans move into shallow areas away from deeper water used by sail boats and then leave lakes entirely if the shorelines are being used by anglers (Buckley 2004). Bellefleur et al. (2006) showed that densities of marbled murrelets were lower in areas with boat densities of one boat per km<sup>2</sup> compared to areas without boats.

In addition to disturbance to fauna, other potential impacts of recreational vessels include pollution from anti-fouling paints (such as tributyltin, TBT), other forms of pollution (oils, sewage), and physical damage to substrate through anchoring, loss of habitat from shore-bank erosion through boat wakes disturbance (Warnken and Byrnes 2004). None of these impacts have been noted on the Tofino Mudflats to-date.

### 5.2.3 Effects of aircraft noise on birds

Wildlife responses to aircraft range from panic to complete habituation. Greater snow geese leave feeding areas where there are more than two over flights per day (Belanger and Bedard 1989). In contrast, black ducks, least terns, red tailed hawks and some cliff nesting seabirds have all shown habituation to aircraft (Buckley 2004).

### 5.2.4 Crowding Displacement from the Big Tree Trail on Meares Island

Several of the ecotour operators mentioned over-crowding at the Big Tree Trail on Meares Island, adjacent to Arakun Flats of the WMA. Over-crowding has started to cause some of the canoe/kayak based tours to develop tours to other locations within the WMA. Questions arise about how much these tours will impact wildlife in the more pristine wilderness areas of the WMA and the overall cumulative impacts from more widely dispersed use throughout the WMA. Answers are needed to decide where to direct use, and where to concentrate use, within the WMA.

High human use of adjacent areas may have two effects that should be monitored: first, as adjacent habitats become more disturbed, the WMA may become more important as a refuge for wildlife. Second, overcrowding may deteriorate edges of the WMA that are most easily accessible and adjacent to the high-use areas. The portion of the Arakun Flats that can be reached from the Big Tree Trail is particularly important as a high tide roost area for shorebirds during spring and summer migration and a storm refuge area for waterfowl during the winter. Spill-over of people to this area should be closely watched and controlled.

### 5.2.5 Effects of Trampling and Digging in the Intertidal Mudflats

At the moment very few people tromp around in the mud of the Tofino Mudflats but those who lead naturalist tours are wondering how to minimize their impacts. They want to find out what their impacts are and what level of exploration is sustainable. They are looking for monitoring that will help them determine how to concentrate (or disperse) their footsteps and digging activities over space and time.

There has been very little research on the impacts of recreation on shoreline invertebrates, and most of what has been done has examined rocky shorelines (e.g., Keogh and Quinn 1998). One study, along the west coast of South Africa, showed that trampling, in sandflats where sandprawns are collected for bait, caused declines in the number of prawns, macrofauna and chlorophyll levels (Wynberg and Branch 1997). Trampling, by itself, had almost the same effect as trampling plus the removal of prawns. The effects of trampling were measurable

(55-80% decrease in prawn densities below those in control sites) at six weeks after disturbance. Levels recovered after 32 weeks (perhaps sooner but sampling was not repeated until after 32 weeks).

Based on their results, Wynberg and Branch (1997) inferred that trampling modifies the nature of the sandflat environment by collapsing sandprawn burrows, compacting the sediment and reducing oxygen levels, all of which can cause mortality for macrofauna. Wynberg and Branch (1997) applied their results by recommending zonal management of Langebaan Lagoon in South Africa with zones determined by the sensitivity of sediments to trampling. The head of the lagoon, where the sediment is very soft and sensitive, is recommended as a ‘wilderness’ area, in which no one is allowed without a permit. This provides a core area for the protection of biodiversity. A limited recreation area is restricted to low impact activities and a multi-purpose recreational area allows for sandprawn-collecting.

Ghost shrimp *Neotrypaea californiensis* (formerly *Callianassa californiensis*) of the Tofino Mudflats WMA are similar to sandprawns (*Callianassa kraussi*) and many other thalassinids. They construct temporary, deep burrow systems and continuously process large amounts of sediment to extract organic material. The intensive bioturbation which results from the burrowing activities of *Callianassa* species has been shown to modify sediment, increase oxygenation and mineralization, and have a range of effects on microalgae, bacteria, meiofauna, seagrasses and algae (Wynberg and Branch 1997, Carty 2001). Ghost shrimp are also an important prey species for fish, migrating shorebirds, crabs and juvenile Grey whales (*Eschrichtius robustus*). Although, ghost shrimp burrows that collapse at low tide are readily re-established (Carty 2001), the effects of trampling are unknown. Disturbance to the animals by trampling and digging could affect the food web and a myriad of other processes.

#### 5.2.6 Effects of Water Pollution on Eelgrass

Loss of eelgrass from estuaries in both North America and Europe has been shown to result from pollution of coastal regions (Orth and Moore 1983, Neinhuis 1983). Short and Burdick (1996) documented progressive loss in eelgrass acreage and fragmentation of eelgrass beds that they related to the degree of housing development and associated nitrogen loading, largely via groundwater, within various sub-basins of an estuary in Massachusetts. Excessive nitrogen loading stimulated algal competitors that shade and stress eelgrass. Losing eelgrass can have serious impacts on coastal ecosystems, including declines in commercial fisheries and migratory waterfowl populations (Short et al. 1987).

### **5.3 Potential Approaches for Monitoring**

#### **5.3.1 Effects of shore walkers, boat and aircraft on birds**

There is sufficient information from the literature to suggest that beach walkers, with and without dogs, boat traffic and aircraft traffic may be having negative effects on birds using the Tofino Mudflats WMA and Chesterman Beach. Thus, it seems more practical and cost-effective to allocate effort to monitoring which will enhance local stewardship, rather than to intensive scientific sampling, which, at best, might verify what is already in the literature.

The proposed techniques for quantifying recreational use by ecotour operators and local residents (from Section 4.3) can easily include options for recording wildlife responses. The focus will be on obvious, immediate changes in wildlife behaviour in response to human presence, i.e., the short-term effects of recreation/tourism (Wilson and Shackleton 2001). However, by involving people who are long-term ecotour operators and residents, it may be possible to cover enough of the area and sustain the effort long enough to link these short-term effects to medium- or long-term effects (e.g., changes in habitat use and population declines).

Two approaches described in Section 4.3 will be used:

- Standardized reporting card for ecotour operators, followed by interviews mid-way and at the end of the season to review the accuracy of the data.
- Standardized reporting forms and interviews with residents living along the Tofino Mudflats (and possibly Chesterman Beach).

The key to running a successful monitoring program will be to train observers to identify particular types of responses and to use a recording form that is quick and easy. Guidance could be provided during the annual staff training sessions held by ecotour companies in Tofino. Ideally, ecotour guides can be encouraged to involve their clients in observing wildlife responses while they are on the tour. That way, observations can be recorded immediately, rather than afterwards when guides are anxious to finish work, and clients will become aware of and involved in the stewardship efforts (R. Vines, pers. comm.). The immediate feedback of this monitoring will inform guides about the impacts of their tours. Cumulative data will be analyzed to determine how frequently wildlife is impacted by recreational use in different areas. A summary of the results will be presented to the companies at the end of each season.

*“There is no doubt a considerable body of expert knowledge among naturalists and wildlife guides about the behaviour of particular species and how to approach them without triggering either flight or attack, but this remains largely unrecorded.”* Ralph Buckley, 2004

Residents, who are willing to participate, will be trained to detect wildlife responses as part of the Welcome Wagon program administered by the Raincoast Education Society. They will be asked whether they are in a position to observe the Mudflats and, if so, they will be trained to record their observations on standardized forms in “rite-in-the-rain” notebooks, or on-line using the West Coast Aquatic Management Board Web Atlas ([www.westcoastaquatic.ca/RIS.htm](http://www.westcoastaquatic.ca/RIS.htm)).

### 5.3.2 Crowding Displacement from the Big Tree Trail on Meares Island

Interviews with ecotour operators who lead tours to the Big Tree Trail is the most effective way to determine how often they use adjacent areas within the WMA. This could be incorporated into the interviews proposed in Section 4.3.

A trail-counter on the Big Tree Trail has a high risk of being tampered with, because of its remote location.

### 5.3.3 Trampling and Digging in the Intertidal Mudflats

Given the limited amount of research on the effects of recreation on soft-bottom intertidal areas, an experimental approach is recommended.

A sampling design similar to those used by Wynberg and Branch 1997 and Lindegarth and Hoskin 2001 could be used to compare the density of ghost shrimp and associated biota at control sites and at sites disturbed by naturalist explorations on the Tofino Mudflats. The design involves randomly selecting 10 areas (3x4 m in size) with similar densities of ghost shrimp holes. Carty (2001) found that ghost shrimp density was significantly related to the number of burrow holes in Grice Bay, especially in summer (June and July). Randomly select five of the sites to be controls (no disturbance), and five to be treatments that will be trampled and explored. Disturbance levels should reflect the normal intensity that results when people are taken on naturalist tours to explore the mudflats. Quantify the disturbance (i.e., count the footsteps and the time spent digging) at the treatment sites. After three weeks take 4 core samples (10 cm diameter, 10 cm deep) from each site. Sieve the samples through a standard mesh size (0.5 mm) and preserve in 7% formalin until they can be sorted. Sort the samples and identify animals to intermediate taxonomic levels, e.g., families for polychaetes, orders or classes for crustaceans, and classes for molluscs. Preserve all animals in 70% alcohol. Compare the mean densities and variation between samples from the control and disturbed sites. Use non-metric multidimensional scaling to compare their community structures (species assemblages).

#### **5.3.4 Water Pollution Effects on Eelgrass**

Researchers from Parks Canada have been monitoring the eelgrass beds and fish communities within Grice Bay, Arakun Flats and Ducking Flats since 2001. They plan to continue monitoring these eelgrass beds annually (J. Yakimishyn, pers. comm.). Strawberry Isle Research Society has mapped and monitored eelgrass beds throughout the Tofino Mudflats WMA, including areas along the Esowista Peninsula (R. Palm, pers. comm.). Both research groups have noted changes in epiphyte cover on eelgrass indicating changes in water quality that may be related to pollution. Community members can contact Rod Palm to volunteer assistance in monitoring.

#### **5.4 Potential Partners**

For monitoring beach walkers, boats and aircraft, we will pursue the same partners as those listed in Section 4.4. Field data forms will be designed to include observations of wildlife responses (see Appendix A for an example). Training materials could be developed with assistance from Dr. Pam Wright, UNBC and Peter Clarkson, Pacific Rim National Park Reserve. They have extensive experience conducting research on recreational use and its effects in Canada's National Parks. The Raincoast Education Society could potentially deliver the training to ecotour operators as a special component of with their Raincoast Host Program each spring. Raincoast Host is designed to teach front-line workers in tourism about local natural and cultural history of the area, and about messages that will encourage visitors to explore the environment safely and respectfully. A field component could be developed that would show tour guides how to classify different wildlife responses.

Any monitoring work done at the Big Tree Trail and areas adjacent to it, will require support from the Tla-o-qui-aht First Nation.

The Tofino Botanical Gardens Foundation and the Raincoast Education Society both lead naturalist tours that involve digging and trampling the mudflats. School groups would be helpful in applying the experimental treatment (i.e., trampling) and advanced university students, with knowledge of marine invertebrates, could be helpful in sampling, sorting, identifying and counting macrofauna.

#### **5.5 Budget Estimate**

Costs estimated in Section 4.5 would cover collecting additional data on wildlife responses to human use. The experiment on mudflat trampling and digging would require an extra three to four weeks of time for coordination, data collecting, analyses, and reporting (\$6000-8000) and supplies and equipment for taking and processing samples (\$1000). Accommodation and meals for volunteer students would be approximately \$3000.

## **6. How can we address negative impacts through education and stewardship programs/materials in a cost-effective way?**

### **6.1 Issue**

The number one issue raised by locals about human impact on wildlife associated with the WMA is about walkers and dogs disturbing birds on Chesterman Beach. Although Chesterman Beach is not within the WMA, it provides critical habitat for migrating shorebirds, less than one kilometer from Doug Banks Flats across the narrow neck of Esowista Peninsula. Chesterman Beach was noted as having one of the highest densities of shorebirds in the Tofino Mudflats region (Butler et al 1992).

Chesterman Beach was identified through a telephone survey in 2006 as the most visited natural area within the District of Tofino (Tofino Parks and Recreation, 2006). It is very popular for beach walkers, joggers, dog walkers, surfers – all of whom potentially cause frequent disturbances to the birds each day. Tofino has a bylaw that requires dogs to be kept on leashes at public beaches, however bylaw enforcement is challenging given that there is only one bylaw officer for the entire municipality. Esrom (2004) found that the leash regulation in Pacific Rim National Park Reserve was ignored by 62% (spring) and 80% (late summer) of the visitors who brought their pets to the Long Beach Unit of the Park. It is reasonable to assume similar (and perhaps lower) levels of compliance with the beach bylaw at Chesterman Beach.

In 2001, signs, providing information about shorebirds, were installed at the three access trails to Chesterman Beach. The signs encourage beach walkers to keep pets leashed and avoid shorebirds during their migration period. The effectiveness of these signs has never been monitored. The Raincoast Education Society is interested in increasing more educational programs and materials to inform beach users about how to be good stewards and share the beach with the shorebirds. A set of materials have been designed for distribution during the migration period of 2007 and 2008. We would like to monitor the effectiveness of these materials.

### **6.2 Background**

The WMA Management Plan recommends signage identifying guidelines for behaviour, viewing and educational and interpretive information, be placed at the parking areas and viewing areas to promote responsible recreational pursuits with minimal environmental impact (Eggen et al. 2002). The Raincoast Education Society is developing signs that will make residents and visitors aware of the importance of providing space to shorebirds at Chesterman Beach. Temporary “Shorebird Alert” signs will be installed during shorebird migration periods (April- May and July to September)

to let people know when they should keep their distance from birds (Figure 2). These signs will be placed beneath existing signs with information about shorebirds. The RES is also planning to distribute bookmarks and fridge magnets with messages about shorebirds and their critical habitats, to people walking on Chesterman Beach during the April-May migration period. Shorebird ambassadors will approach people on the beach and talk to them about shorebirds when they hand out the bookmarks. The RES is interested in monitoring whether these efforts are effective. They are asking: “Do our messages reach the right audience and do they make this audience care enough to give shorebirds adequate space on the beach?”



Figure 2. Signs designed for installation at Chesterman Beach access trails.

### **6.3 Potential Monitoring Approach at Chesterman Beach**

We propose monitoring the behaviour of people at the beach before and after the educational messaging is presented in person, or installed as a sign. A sampling technique similar to one designed to detect the influence of human activity on birds (e.g., Burger and Gochfeld 1991, Esrom 2004) could be used to observe the behaviour of people when they encounter birds. Chesterman Beach is approximately 2 km long. An observer could collect data every time people and birds are encountered while walking a transect (50 m from the surf to avoid the birds) along the beach (B.C. Ministry of Environment 1997). Observers would record the total number of encounters with people/dogs and birds, the number of times that people (and dogs) disrupt birds, and the number of times that people (and dogs) avoid birds. Disruptive behaviour would be defined as walking too close to birds (<50 m), running at birds, allowing dogs to run at birds, throwing things (e.g., sticks) at birds. Avoidance behaviour would include walking around birds (i.e., by 50 m), having dogs on leash, or heeled, within 100 m of birds, and stopping and watching birds from a distance (i.e., 50 to 100 m). See Appendix B for a possible field data form. Observation periods before and after educational activities (treatments) would occur at

similar tide levels (within 3 hr of low tide when birds are likely to be foraging) and similar times of the day (daylight hours when people are likely to be visiting the beach).

Interviews with beach walkers could happen when educational materials are handed out. (e.g., Interviews with every 4<sup>th</sup> willing person, or every 10 minutes). The first question: “Did you know that migrating shorebirds are stopping over to feed on the beach”? could be followed by a few quick questions about the person’s knowledge and attitude about how to minimize disturbance.

#### **6.4 Partners**

The Raincoast Education Society has received funding from the Habitat Conservation Trust Fund, the Clayoquot Biosphere Trust, Tofino Chamber of Commerce and B.C. Ministry of Environment to develop educational materials. Monitoring our effectiveness is part of the requirement for continued HCTF support. Assistance from a graduate student or a class of senior students in Environmental Studies or Recreation and Tourism Management is being sought.

#### **6.5 Budget Estimate**

The costs for assessing the effectiveness of the education program at Chesterman Beach would be for an observer’s wages for four to six weeks (\$3000-4500) in addition to the funds required to distribute the educational materials. An additional \$2500 would be needed for coordination, data analyses and report writing.

### **7. Can we plan for (inevitable) future expansion of tourism and recreational use so that it will occur in a controlled, well-managed way at particular locations and, as such, have minimal impact?**

#### **7.1 The Issue**

Municipal and Area C (Alberni Clayoquot District) lots adjacent to the Tofino Mudflats WMA are scheduled for development within the lifetime of current land owners. Proposals have come forward to develop access points and educational facilities, viewing blinds, etc. at these sites. The Tofino Mudflats WMA Advisory Committee and the B.C. Ministry of Environment will be asked to make decisions about whether or not to allow these facilities. Such decisions will be difficult and potentially controversial. They must be defensible in the court of public opinion. Information collected by monitoring baseline recreational use and the frequency of wildlife interactions, will help shape management decisions. Ideally, monitoring information will feed into a formal decision-making framework that offers a defensible process for defining desired future resource conditions for visitor impact management, identifying impact indicators and assessing impact acceptability, conducting problem analyses, and evaluating and selecting preferred management actions (Leung and Marion 2000).

## **7.2 Background**

The Management Plan for the WMA included a Wildlife Viewing and Recreation Management Report that analyzed the strengths, weaknesses, opportunities and threats (SWOT) of potential locations for developing wildlife viewing and recreation sites (Eggen et al. 2002). The analysis was based on informal site inspections. The authors recommended investigating the SWOT further before decisions for developing viewpoints and trails are made.

*“Critical areas should be further studied and clearly defined and a higher level of protection should be provided. Further protection could be intermittent ‘no go zones’ during migration periods or permanently closed areas.”* Eggen et al. 2002.

## **7.3 Proposed Approach**

The Tofino Mudflats WMA Advisory Committee would like to find a graduate student with an interest in developing a framework for impact management decision-making for the Tofino Mudflats WMA.

## **7.4 Potential Partners**

Graduate programs in tourism and recreation management are offered at UNBC and SFU. The Geography Department at the University of Victoria also offers opportunities for graduate students to explore decision-making processes in establishing Marine Protected Areas. Contacts include: Dr. Pam Wright (UNBC), Dr. Rosaline Canessa (U Vic).

## **7.5 Budget Estimate**

Funding requirements include wages for a graduate student (\$18,000/year), and travel (\$2500, depending on the location of the university). In kind support would include office/library facilities at the university, time from the supervisory committee and time from the WMA Advisory Committee.

## **8. Personal Communications**

Boychuk, Stan. February 2007. Executive Director, Clayoquot Biosphere Trust.

Clarkson, Peter. February 2007. Assistant Chief Park Warden, Pacific Rim National Park Reserve, seabird monitoring specialist,.

Hansen, Bob. January 2007. Warden, Pacific Rim National Park Reserve, large carnivore management specialist.

Martin, Carl. February 2007. Master canoe carver, Tla-o-qui-aht First Nations.

Martin, Giselle. November 2006. Owner and guide for Tla-ook Adventures, providing cultural tours in traditional Tla-o-qui-aht canoes.

Martini, Kati. November 2006. Owner and Manager of Remote Passages Kayak and Boat Ecotourism Company.

Mole, Sally. November 2006, and February 2007. Director of Parks and Recreation for the District of Tofino.

Olive, Caron. November 2006. Consultant who reviewed resource monitoring in the Tofino Mudflats WMA in 2005. Caron is also developing the Aquatic Management Board web atlas.

Osborne, Josie. November 2006. Board Member of the Tofino Botanical Gardens Foundation and the Raincoast Education Society.

Patterson, George. November 2006. Director of the Tofino Botanical Gardens Foundation.

Reid, Tom. February 2007. Manager for Tofino Mudflats WMA on behalf of B.C. Ministry of Environment and The Nature Trust of Canada.

Rogers, Aaron. November 2006. Pilot for Tofino Air.

Stere, Tom. November 2006. Senior kayak guide with Tofino Sea Kayaking and landowner living along the shoreline of the WMA.

Tilitzky, Michael. October 2006. Manager of the Tofino Chamber of Commerce and Councillor for the District of Tofino.

Travers, Don. November 2006. Owner and Manager of Remote Passages, kayak and boat ecotourism company.

Thomas, Gary. November 2006. Director of Tofino Streamkeepers, member of the Tofino Mudflats WMA Advisory Committee, and landowner living along the shoreline of the WMA.

Vines, Rebecca. March 2007. Research Coordinator for Clayoquot Biosphere Trust.

Wilson, Carl. February 2007. Warden for B.C. Parks in Clayoquot Sound.

Wright, Pam. November 2006, March 2007. Specialist in recreational monitoring and management within protected areas, and faculty member in the Outdoor Recreation and Tourism Management program at the University of Northern B.C.

Yakimishyn, Jennifer. January 2007. Researcher involved in monitoring fish communities and eelgrass beds, Pacific Rim National Park Reserve.

## 9. Literature Cited

Belanger, L. and J. Bedard. 1989. Responses of staging greater snow geese to human disturbance. *Journal of Wildlife Management* 53: 713-719.

Bellefleur, D., P. Lee and P. Shepherd. 2006. Boat disturbance and marbled murrelets in Pacific Rim National Park Reserve: Does SARA apply? Abstract presented at the BC Protected Area Research Forum, Victoria, B.C.

Bliss, J., G. Aplet, C. Hartzell, P. Harwood, P. Jahnige, D. Kittredge, S. Lewandowski, and M Soscia. 2001. Community-based ecosystem monitoring. *Journal of Sustainable Forestry* 12: 143-167.

B.C. Ministry of Environment, Lands and Parks. 1997. Standardized Inventory Methodologies for Components of British Columbia's Biodiversity: Shorebirds. Resource Inventory Branch, Terrestrial Ecosystem Task Force, Victoria, BC.

Buckley, R. 2004. Impacts of ecotourism on birds. In R. Buckley, ed. *Environmental Impacts of Ecotourism*. CAB International, Oxfordshire, U.K.

Burger, J. 1981. The effect of human activity on birds at a coastal bay. *Biol. Conserv.* 21: 231-241.

Burger, J. 1994. The effect of human disturbance on foraging behaviour and habitat use in Piping Plover. *Estuaries* 17(3): 695-701.

Burger, J. and Galli. 1980. Factors affecting distribution of gulls (*Larus* spp.) on two New Jersey coastal bays. *Environmental Conservation* 7: 59-65.

Burger, J. and M. Gochfeld. 1991. Human activity influence and diurnal and nocturnal foraging of Sanderlings (*Calidris alba*). *Condor* 93 (2): 259-265.

Butler, R.W., A. Dorst, and M.A. Hobson. 1992. Seasonal abundance and biomass of birds in eelgrass habitats in Browning Passage on the west coast of Vancouver Island. In *The ecology, status and conservation of marine and shoreline birds on the west coast of Vancouver Island*. Edited by K. Vermeer, R.W. Butler and K.H. Morgan. Canadian Wildlife Service Occasional Paper Number 75, Ottawa.

Carty, Sarah. 2001. *Zostera marina* and *Neotrypaea californiensis* as indicators of ecosystem integrity in Grice Bay, British Columbia. M.Sc. Thesis. University of British Columbia.

District of Tofino. 2006. Parks and Recreation Master Plan Review. Second Draft. District of Tofino. 37pp.

Eggen, M., S. Diggon, and A. Mason. 2002. Wildlife Viewing and Recreation Management in the Tofino Mudflats Wildlife Management Area. Ministry of Water, Land and Air Protection, Nanaimo, B.C.

Esrom, J. A. 2004. Dogs, shorebirds, and conflict management: recreation and ecological integrity at Long Beach, Pacific Rim National Park Reserve, British Columbia. M.Sc. Thesis. York University.

Hockin, D., M. Ounsted, M. Gorman, D. Hill, V. Keller, and M.A. Barker. 1992. Examination of the effects of disturbance on birds with reference to its importance in ecological assessment. *Journal of Environmental Management* 36: 253-286.

Keough, M.J. and Quinn, G.P. 1998. Effects of periodic disturbances from trampling on rocky intertidal algal beds. *Ecological Applications* 8: 141-161.

Knight, R.L. and D.N. Cole. 1995. Wildlife responses to recreationists. In Knight, R.L. and K.J. Gutzwiller, eds. *Wildlife and coexistence through management*. Island Press, Washington, D.C.

Leung, Y-F. and J.L. Marion. Recreation impacts and management in wilderness: a state-of-knowledge review.

Lindgarth, M. and M. Hoskin. 2001. Patterns of distribution of macro-fauna in different types of estuarine, soft sediment habitats adjacent to urban and non-urban areas. *Estuarine, Coastal and Shelf Science* 52: 237-247.

Neinhuis, P.H. 1983. Temporal and spatial patterns of eelgrass (*Zostera marina* L.) in a former estuary in the Netherlands, dominated by human activities. *Mar. Tack. Soc. J.* 17: 69-77.

Olive, C. 2005. Stewardship and Monitoring in the Tofino Mudflats WMA. Report to Clayoquot Biosphere Trust and Habitat Conservation Trust Fund.

Orth, R.J. and K.A. Moore. 1983. Chesapeake Bay: an unprecedented decline in submerged aquatic vegetation. *Science* 22: 51-52.

Shepherd, P.D.F. and J.S. Boates. 1999. Effects of a commercial baitworm harvest on semipalmated sandpipers and their prey in the Bay of Fundy Hemispheric Shorebird Reserve. *Conservation Biology* 13: 347-356.

Short F.T. and D.M. Burdick. 1996. Quantifying eelgrass habitat loss in relation to housing development and nitrogen loading in Waquoit Bay, Massachusetts. *Estuaries* Vol. 19(3): 730-739.

Short, F.T., L.K. Muehlstein, and D. Porter. 1987. Eelgrass wasting disease: cause and recurrence of a marine epidemic. *Biol. Bull.* 173: 557-562.

Tourism Association of Vancouver Island and The Recreation and Tourism Research Institute at Malaspina University-College. 2003. Tourism Labour Market Research Project. Summer Visitor Survey Results. HRDC Report.

Tuite, C.H., M. Owen, and D. Paynter. 1983. Interaction between wildfowl and recreation at Llangorse Lake and Tlybont Reservoir, South Wales. *Wildfowl* 34: 48-63.

Tuite, C.H., P.R. Hanson, and M. Owen. 1984. Some ecological factors affecting winter wildfowl distribution on inland waters in England and Wales, and the influence of water-based recreation. *Journal of Applied Ecology* 21, 41-62.

Warnken, J. and T. Byrnes. 2004. Impacts of tourboats in marine environments. In R. Buckley, ed. *Environmental impacts of ecotourism*. CAB International, Oxfordshire, U.K.

Watson A.E., D.N. Cole, D.L. Turner and P.S. Reynolds. 2000. *Wilderness Recreation Use Estimation: A Handbook of Methods and Systems*. USDA Forest Service. General Technical Report RMRS-GTR-56.

Wilson, S.F. and Shackleton. 2001. Backcountry recreation and mountain goats: a proposed research and adaptive management plan. B.C. Ministry of Environment, Lands and Parks Wildlife Bulletin B-103.

Wright, P.A. 1996. Level of Use Methods. Jasper River Use Study. Appendices. Centre for Tourism Policy and Research, School of Resource and Environmental Management, Simon Fraser University, Burnaby, B.C.

Wynberg, R.P. and Branch, G.M. 1997. Trampling associated with bait-collection for sandprawns *Callinassa kraussi* Stebbing: effects on the biota of an intertidal sandflat. *Environmental Conservation* 24(2): 139-148.

Yalden, D.W. and P.E. Yalden. 1989. The sensitivity of breeding golden plovers *Pluvialis apricaria* to human intruders. *Bird Study* 36: 49-55.

Yalden, P.E. and D.W. Yalden. 1990. Recreational disturbance of breeding golden plovers *Pluvialis apricarius*. *Biological Conservation* 51: 243-262.

**10. Appendix A.**

WMA Use Reporting Form for Ecotourism Companies in Clayoquot Sound

*Information you provide will help determine ways to manage for high quality experiences for visitors while maintaining the ecological integrity of the Tofino Mudflats WMA.*

Company Name \_\_\_\_\_

Phone Number \_\_\_\_\_

Guide Name \_\_\_\_\_

Page \_\_\_\_ of \_\_\_\_

Date	Time Start	Time End	# of clients /boats	WMA Location (Please circle area(s) visited)	Wildlife Observed? (Please circle one or more)	Wildlife Response (Please circle one or more)
				Arakun/ Ducking/ Mikes Islands/ Doug Banks/ Jensen's Bay/ Maltby Slough Other: _____	None/ Ducks/Geese/ Hérons/ Seabirds/ Shorebirds/ Bears/Otters/ Mink/ Other: _____	None/ Became Alert/ Stopped Feeding/ Moved Further Away/ Left the Area/ Did Not Return/ Other: _____
				Arakun/ Ducking/ Mikes Islands/ Doug Banks/ Jensen's Bay/ Maltby Slough Other: _____	None/ Ducks/Geese/ Hérons/ Seabirds/ Shorebirds/ Bears/Otters/ Mink/ Other: _____	None/ Became Alert/ Stopped Feeding/ Moved Further Away/ Left the Area/ Did Not Return/ Other: _____
				Arakun/ Ducking/ Mikes Islands/ Doug Banks/ Jensen's Bay/ Maltby Slough Other: _____	None/ Ducks/Geese/ Hérons/ Seabirds/ Shorebirds/ Bears/Otters/ Mink/ Other: _____	None/ Became Alert/ Stopped Feeding/ Moved Further Away/ Left the Area/ Did Not Return/ Other: _____

Were there any other visitors within the WMA while you were present? \_\_\_\_\_

If so, what activities were they doing? \_\_\_\_\_

Wildlife responses to them? \_\_\_\_\_

## 11. Appendix B.

Proposed Field Data Form for Recording the Frequency of Human Behaviour in Relation to Shorebirds at Chesterman Beach

Observer: \_\_\_\_\_

Date: \_\_\_\_\_ Time Start: \_\_\_\_\_ Time End: \_\_\_\_\_

Tide: low ..... mid..... high Tide: rising.....slack.....falling

Width of Beach: (approximate number of paces) \_\_\_\_\_

Encounter #	Time	# of people	Flock size	Distance between people and birds. Circle one:	People disturbed birds? How? Circle one:	People avoided birds? How? Circle one:	Flock Flushed? Circle one:	Comments
1				<10 m 10-30 m 31-50 m 51-100 m >100 m	Y or N - Too fast - Too noisy - Too close - Dog chased - Threw object	Y or N - Moved away - Stopped - Leashed/ heeled dog - No Dog	Y or N	
2				<10 m 10-30 m 31-50 m 51-100 m >100 m	Y or N - Too fast - Too noisy - Too close - Unleashed dog - Threw object	Y or N - Moved away - Stopped - Leashed/ heeled dog - No Dog	Y or N	
3				<10 m 10-30 m 31-50 m 51-100 m >100 m	Y or N - Too fast - Too noisy - Too close - Unleashed dog - Threw object	Y or N - Moved away - Stopped - Leashed/ heeled dog - No Dog	Y or N	
4				<10 m 10-30 m 31-50 m 51-100 m >100 m	Y or N - Too fast - Too noisy - Too close - Unleashed dog - Threw object	Y or N - Moved away - Stopped - Leashed/ heeled dog - No Dog	Y or N	
5				<10 m 10-30 m 31-50 m 51-100 m >100 m	Y or N - Too fast - Too noisy - Too close - Unleashed dog - Threw object	Y or N - Moved away - Stopped - Leashed/ heeled dog - No Dog	Y or N	
6				<10 m 10-30 m 31-50 m 51-100 m >100 m	Y or N - Too fast - Too noisy - Too close - Unleashed dog - Threw object	Y or N - Moved away - Stopped - Leashed/ heeled dog - No Dog	Y or N	

## 12. Appendix C.

Questions for determining the scope of the proposal for monitoring recreational use of the Tofino Mudflats WMA

*Thank you for participating. Your responses will help to determine the type of monitoring that needs to be done on the Tofino Mudflats WMA. Your name will be listed as a person contacted in preparing the proposal, unless you request otherwise.*

1. What do you value about the WMA?
2. Does your business use the WMA area?
  - a) Where do you go?
  - b) What time of the year, how often (per day/week/month)?
  - c) How long do you spend at a time?
3. Why do you go there? Do you go there for different reasons depending on the season?
4. Do you know others (individuals/businesses) that use the WMA for recreation? Do they affect your use of the area?
5. Are you interested in finding out how much the Mudflats are used for recreation?
6. Are you curious about the effects of recreational use on the wildlife using the WMA? What sort of effects would you expect to see, if any?
7. What questions would you like to see addressed by monitoring recreational use and its effects? (e.g., number of visitors by season/time of day, maps of use by frequency, frequency of interaction/disturbance to water birds, etc.?)
8. Are you aware of educational materials and programs about the Mudflats?
9. Are these helpful in reducing impacts? Can you suggest other educational materials that would be helpful?
10. Are you interested in finding out what educational materials are most effective at reducing impacts?
11. What kind of monitoring approaches would you like to see? (E.g., questionnaires, interviews, trail counters, webcam, other ideas?)
12. Would you support or participate in the monitoring? For example:
  - a) Track and report the number of recreational trips you lead to the Mudflats?
  - b) Record your observations about wildlife responses to your presence?
  - c) Administer questionnaires that ask visitors about the value of educational information?
  - d) Can you offer other kinds of support?