

Section 8.0 CONCLUSIONS

Section 1 Fish Survey and Water Sampling

- There were 20 species of fish found in the Englishman Estuary during the sample period.
- Three Spine Stickleback, Staghorn Sculpin and Shiner Perch were the most common fish.
- Pink were the most common salmon. Chinook, Coho and Chum were also captured.
- All fish were evenly distributed through the Beach, Lagoon and Dyke with fewest along the River.
- Salmon juveniles were captured in the estuary from March to July but not in August.
- There appeared to be no changes in fish population abundance since the 1993 study although methods for sampling were different.
- Water quality from the City storm drains that enter the estuary is poor in terms of Coliform, Metals and PAH.
- Volunteers contributed approximately 650 hours towards the fish surveys. These surveys could not have been done without their help.
- There were 20 species of fish found in the Englishman Estuary during the sample period.
- Three Spine Stickleback, Staghorn Sculpin and Shiner Perch were the most common fish.
- On going studies of fish communities should continue in order to census species utilizing the estuary, fish population changes and habitat utilization in estuary areas.

Section 2 Vascular Plants, Plant Communities and Ecosystems

A method was developed and tested for mapping vascular plants, plant communities and ecosystems based on 5 steps: delineation, sampling, data management, classification, and mapping. This project was made possible because enthusiastic volunteers put in the many hours of training and field work required to complete delineation and sampling of that part of the the estuary that existed in 1976. This method would be easily transferable to other estuaries and to any natural area that is close to an interested and involved population. To facilitate comparisons over time, the classification system used to map the estuary in 2008 was similar to that in 1976, but in 2008 the system was based on 26 observed plant associations -- the 19 used in 1976 plus 7 more. A map entitled "Some Plant Communities of the Englishman River Estuary in 2008" was produced based primarily on several hundred polygons classified by the vegetation cover observed at over 100 sample sites and several thousand UTM data points that marked edges and transitions.

It was found that major changes had occurred during the period from 1976 to 2008, especially in areas where Lyngbye's Sedge had once been described as dominant in terms of species cover/abundance. Most of the areas that supported plant communities with *Carex Lyngbyei* in 1976 were, by 2008, simplified to the point where Lyngbye's Sedge was gone from much of it. In that time, the plant biomass appeared to have decreased to a fraction of what it would have likely been in 1976, based on the volume of plant matter usually associated with the plant communities that Kennedy (1982) described.

Observations of footprints, feces, cut stems, leaves and roots of vegetation, patterns where the vegetation cutting either has or has not occurred in relation to access and disturbance, selective disappearance of certain species (possibly preferred food species) from some areas over time, and some direct observations of waterfowl grazing during the day, indicated that some parts of the estuary vegetation, and often the substrate as well, have been dramatically affected by the Canada Goose.

If the substrate was involved, it was pitted, or eroded at the edges, or slumping down into the tidal channels, or in some cases, it was gone altogether. Slumping of the marsh substrate into the tidal channel made the channel more shallow and it changes its shape and elevation so that standing water was absent at low tide, in some locations. Slumping also seemed to have removed the overhanging vegetation that would otherwise have shaded the channel waters and helped to hide the inhabitants from predation. These changes can be expected to have a major impact on fish.

Another force for change has been the river moving its main channel on the estuary further east since 1976. However important this powerful current of water may be to the vegetation patterns observed, it does not explain the transformation in vegetation that occurred in areas where the river flow patterns appear to have remained unchanged since 1976, based on ortho photo interpretation and field observation of erosion and deposition. Other possible processes for change were also considered.

In summary 3 factors appear to account for the vegetation changes observed since the Kennedy made her observations in 1976:

- 1) movement of the river's main channel in an easterly direction
- 2) breaching of the dyke
- 3) grazing by Canada Geese

In the areas where the natural estuary vegetation had expanded since 1976 because the western dyke was breached in 1979, a similar volunteer-based method was used to delineate and sample vegetation as the first steps in the process of creating a Biogeoclimatic Ecosystems Classification map of the entire estuary.

It was found that a large area of the western part of the estuary (the West Marsh/ Lagoon) supported a plant community that is a likely occurrence of the CDFmm/Em03 *Distichlis spicata* Ecosystem which is RED-listed (equivalent to "endangered" or "threatened") by the Province of BC. Near the tidal channels, this ecosystem appeared to be complexed with the CDFmm/Em02 *Salicornia virginica-Glaux maritima* Ecosystem which is also RED-listed. Two other plant communities were identified thus far with likely correspondence to existing BEC classifications: the CDFmm/Em01 *Ruppia maritima* Herbaceous Vegetation Ecosystem which is also RED-listed, and the CDFmm Em05 *Carex lyngbyei* Herbaceous Vegetation Ecosystem which is BLUE-listed. This volunteer work is ongoing.

This project confirmed many plant species presence on the estuary and it added at least 3 new plant species to previous lists: Shore Buttercup (*Ranunculus cymbalaria*), Brass Buttons (*Cotula coronopifolia*), Hazelnut (*Corylus spp.*, either Beaked Hazelnut (*Corylus cornuta*), a native species, or European Hazelnut (*Corylus avellana*), an introduced species that has naturalized.

Section 3 Terrestrial Fauna

The confirmed observations that volunteers and staff in this study made of terrestrial animals produced records that totaled 24 species. Many of the observations were recorded with UTM coordinates from a GPS unit so these records added to the mapping of animal uses as part of mapping special places and features on the estuary. The observations are presented in text form for management purposes and are in the process of being developed into maps for easier visual interpretation.

The team of Arrowsmith Naturalists that undertook a systematic monthly bird survey from 2005 to 2009 observed 143 species of birds. They have generously allowed us to share their data. Of the birds that were observed, either by the naturalist or as part of this study, the Western Grebe and Short-eared Owl are RED-listed and the Peregrine Falcon (local *pealei* subspecies) and the Great Blue Heron (local *fannini* subspecies) are BLUE-listed. A number of other listed (endangered, threatened, of special concern) animal taxa, such as the Vancouver Island subspecies of Common Water Shrew or Navigator Shrew (*Sorex palustris brooksi*) and the Vancouver Island subspecies of Ermine or Short-tailed Weasel (*Mustela erminea anquinae*) are likely present on the estuary but their presence was not confirmed in this study.

Section 4 Mapping Special Places and Features on the Estuary

The purpose of this part of the project was to record some of the places that might be of special importance to someone trying to make an ecosystem-based management decision about the estuary. The concept was introduced to volunteers and the results suggest that some understanding and appreciation has been developed. Thus, this technique is a useful tool to bring together the public, the land owners and the land managers. The results documented 26 locations on the estuary that are of particular importance to certain species. It is expected the list will grow to many times that number as the photographs and records are processed by volunteers and, as new data is collected. The result will be a map where these features will be conveniently visible to anyone making decisions that might affect the estuary.

In addition, this field-based process coupled with a review of the literature, highlighted the need for some specific spatial data. For example, the Band-tailed Pigeons that were recorded using the estuary in this study are likely to be dependent on a mineral resource whose geographic location is not known. Similarly, the roosting spot that hundreds of Northwestern Crows depend on is on or near the estuary but not yet located. In another example, a few solitary bee condominiums were located that might be important to many species of plants and animals, but a careful inventory of the estuary in the autumn would be needed to locate the remainder of these condominiums.

The process of doing inventory, as described in the section on Vascular plants, Plant Communities and Ecosystems, and the section on Invasive Species, has created a database of occurrences of listed (endangered, threatened) plant communities, thus providing another layer of information that could be useful to guide decisions about the estuary. The information will be mapped to make it conveniently accessible.

Section 5 Invasive Species

The presence of more than 30 invasive plant species was confirmed on the Englishman River estuary. This number is expected to rise as confirmation found for many other invasive species.

This part of the project involved the greatest amount of volunteer effort: approximately 34 people were involved in various training activities, 9 volunteers and 2 students were involved in walking the estuary and marking the locations of invasive species with a GPS, either as part of a volunteer field work team or working with a biologist. Experiments with control of some species, especially English Ivy, involved 2 volunteers and 2 students spending 4 days of physical labour clearing the vines off of 7 large trees and approximately 20 shrubs. In total, approximately 684 hours of unpaid volunteer time was given to the invasive species part of this project, not including the many hours that the Arrowsmith Naturalists spent pulling Scotch Broom and knapweed.

Another result was maps of Scotch Broom, English Ivy and Lesser Periwinkle distributions on the estuary using a combination of ground records and orthophoto interpretation. Maps of occurrences of knapweed, Armenian Blackberry, European Holly, Spurge Laurel and Yellow Archangel were also made and these are still being added to. This project has identified a need for distribution maps of Robert Geranium, Quackgrass and Field Bindweed but volunteers have not yet started on these tasks.

From the maps, recommendations for inclusion in a detailed management plan for those species was developed, starting with Scotch Broom.

In this study, the Canada Goose was considered an invasive species because the local population of the Canada Goose is recently established and still growing, and already it appears to exceed the carrying capacity of the estuary. In addition, the genetics and behaviour of these birds appears to be different from any of the smaller, native migratory Canada Geese that would sometimes visit the Englishman River estuary in small numbers for a brief period. Further conclusions about the Canada Goose and how it may be affecting vegetation and fish are presented under the heading Conclusions Section 2 -- Vascular Plants, Plant Communities and Ecosystems.

In the process of advertising, in door to door delivery of brochures, and in public events such as Rivers Day, many people were exposed to the problems of invasive species, how they spread and the how everyone can help to control and eradicate some of them. At the end of the project, it appears that there are enough interested people forming a network to complete many more of these tasks in the near future.

Section 6 Nearshore Studies - Shoreline Inventory

- The hardening and modification of the shoreline is greatly altering and so having a negative effect on the ecological functions of the shore of the Parksville-Qualicum Beach area, and the Englishman River estuary.
- We need to educate the public, developers, elected officials and property owners about alternatives to armouring a shoreline.
- We need to review the possibilities for restoration of softshores within the study area.
- We need to have laws to protect our nearshore including local bylaws and enforcement of the Fisheries Act.
- We need to review our shoreline variances in order to understand how shoreline modifications are approved and then develop tools and/or a revised process to assist in better decisions regarding nearshore health.

Section 6 Nearshore Studies – Marine Riparian Areas

The marine riparian area has been impacted by development. It provides important biological function to the nearshore and to humans.

- A more complete study of the marine riparian area should be conducted.
- A study of the marine riparian vegetation that is not in existence but should be needs to be completed.
- Information from such a study should be shared through education programs, and incentives given to plant and restore the riparian zone.
- Bylaws to prevent introductions of known invasives and encourage removal of existing invasives should be considered.

Section 6 Nearshore Studies - Eel Grass Mapping

The eelgrass beds of Parksville-Qualicum Beach cover a significant distance of shoreline. Changes in behaviour seem to be occurring – movement up the beach, possible stabilization of *Z. japonica*, change in timing of ephiphytes.

We need to:

More research is needed to explain these changes and potential impacts on food chains in the ocean.

Water quality may be an issue, contributing to changes in behaviour of the *Z. marina*. Attempts should be made to determine whether any water quality issue is due to local influence, or a regional issue or concerns the whole of Georgia Basin.

The Bamfield Marine Science Centre is currently researching wasting disease and will work with the Seagrass Conservation Working Group to promote partnerships in research and management in the Georgia Basin and West Coast of Vancouver Island. MVIHES and land managers should continue to work together on this research.

Once reasons for decline have been identified, consideration of transplants would be possible.

Mapping of *Zostera Japonica* should be undertaken to monitor the area it has taken, but also any changes in behaviour that may be significant. This would include a detailed study comparing growth rates of *Z. Marina* to *Z. Japonica*.

An ecosystem approach must continue in monitoring of eelgrass, relating the habitat to other species that benefit from healthy eelgrass beds, and human actions that can impair the health of the system

mapping of kelp in the area would be useful and help complete the picture of nearshore function

Section 6 Nearshore Studies - Forage Fish Mapping

The beaches of Parksville-Qualicum Beach seem to offer a selection of locations for Sand Lance and Surf Smelt habitat.

Mapping for Pacific Smelt should be completed as well, using a methodology similar to that used for Sand Lance.

Sand Lance spawning sampling need to be collected in November, and early December.

Several years of data collection should occur in order to capture the movement of Sand Lance use of different beaches over time.

A photo-point monitoring program to identify and monitor forage fish habitat should be considered to cover one year once/ month, or a program covering a wider selection of beaches 4 times/year may be enough.

This section of coastline contributes 3-4 percent of herring spawn habitat for the province. Of the herring spawn mapping done within the study area, there are many areas that indicate a high use zone.

Considering the acknowledged value of sea grasses to herring, continued monitoring of eelgrass and the addition of mapping kelp in the area would be of value to forage fish management.

Acknowledgement of the value of the local nearshore to the herring and the many food chains dependent on herring, needs to occur. This information should be included in a variety of education programs.

There should also be further development of policies and regulations to protect and restore the fisheries habitat.

Section 6 Nearshore Studies – Looking at the Nearshore

As expected before the study was done, the nearshore is a complex zone as a result of many interrelationships, some of which are still not well understood. In order to ensure a healthy nearshore in the study area a multi-faceted approach will be necessary.

Actions should include:

- The combination of harvesting eelgrass and kelp for gardening and cleaning up the “messy” beaches are stripping beaches of important nutrients. An education program focused on both the coastal home owner, and the avid gardener would be a useful next step.
- A more detailed review of the marine riparian area would be extremely useful to indicate health of the whole nearshore, and possible management actions and best practices to suggest to property owners.
- There is a need to raise the profile of the Canada Goose issues and create an understanding and support or potential solutions through development and implementation of a public education program. This would include presentations to the public, mainstream animal rights groups and other key audiences.
- The role of groundwater in the estuary and nearshore areas is an area that has not been well studied. Further research is needed in order to determine the role of groundwater in an

estuary and nearshore areas generally and the ER estuary and nearshore specifically. This needs to be completed before further water management planning is conducted for the area.

- There are some real concerns over the future of water supplies to the estuary and nearshore. Studies should be done to clarify flow, salinity and DO within the estuary to better understand what levels are required and set baselines in different areas of the estuary. Similar work should be done within the nearshore as well.
- This study has shown some of the complexity of the nearshore and this information should be communicated to the public, land managers and politicians. A communications/education program would help increase understanding and support for various management approaches and protection of the nearshore.
- As public understanding and support grow, a regional shoreline planning process would be a strong step towards a wide-ranging healthy nearshore.

Section 7 Public Involvement

There is definitely an interest in the community in participating in citizen science, or the stewardship of their ecosystems. By using a variety of methods to contact the community and engage them, a range of resident type and a good number of residents were reached with messaging and/or a chance for a hands-on experience.

- Given the value placed on the estuary by the community, it is important that upcoming OCP reviews consider these values. Bylaws protecting estuary and nearshore areas should be reviewed
- Public education programs regarding the function of their estuary and nearshore and how to care for them should be offered. Topics could include invasive plants and how to remove them, alternatives to seagrasses and algae in the garden as fertilizer, role of the wrack line on the beach, alternatives to hardening, etc.
- Continued opportunities for stewardship and monitoring should be offered. Topics could include alternatives to pesticides, herbicides and fertilizers; continued monitoring of the estuary and nearshore elements of this study such as vegetation, fish distribution, water flow monitoring, etc.