Section 5 INVASIVE SPECIES

5.1 Introduction

Vancouver Island is unique in that its native ecosystems seem to lack many of the species present just across the water on the mainland such as the Grizzly Bear (*Ursus arctos*), Lynx (*Lynx canadensis*), Bobcat (*Lynx rufus*), Coyote (*Canis latrans*), Red Fox (*Vulpes vulpes*), Long-tailed Weasel (*Mustela frenata*), Fisher (*Martes pennanti*), all species of skunks (*Spilogale gracilis* and *Mephitis mephitis*), Snowshow Hare (*Lepus americanus*), Rocky Mountain Pika (*Ochotona princeps*), Porcupine (*Erethizon dorsatum*), Mountain Beaver (*Aplodontia rufa*), Flying Squirrel (*Glaucomys sabrinus*), Bushy-tailed Woodrat (*Neotoma cinerea*), Douglas Squirrel (*Tamiasciurus douglasii*), all species of chipmunks (*Tamias townsendii* and *Tamias amoenus*) and a number of other species of rodents, all species of moles (*Scapanus orarius* and *Neurotrichus gibbsii*), Masked Shrew (*Sorex cinereus*), Black-capped Chickadee (*Parus atricapillus*) and Leopard Frog (*Rana pipiens*). It appears that Vine Maple (*Acer circinatum*) and the large birches native to B.C. (*Betula occidentalis* and *Betula papyrifera*) are two of the many mainland plants that are not native to the Island. The absence of each of these species means that the ecosystems present on Vancouver Island are different in ways that may be subtle or gross.

In addition, Vancouver Island supports a number of species or subspecies of plants and animals that occur nowhere else in the world. Each of these endemic taxa may have behaviour and morphology that is adapted, often through an expanded niche, to the unique situation on the Island. This means Vancouver Island, like Hawaii and New Zealand and many other biogeographic "islands" (islands, lakes, or mountain ranges that have been isolated) has some taxa, ecosystems and behavioural strategies that can only be viewed alive, in place, on that island.

In Australia, the concern about invasive species is high. If one species of rabbit and one species of cactus, to name just two examples, could cause major economic and ecological problems, the concern is about what else was possible. At one time, everything from the tires of the aircraft to the shoes of the air travelers were cleaned upon entry to prevent the unwelcome arrival of seeds and other organisms that might turn their whole ecological and economic picture upside down.

Meanwhile on Vancouver Island, people continue to import and cultivate those non-native species that have the capability of escaping and naturalizing, such as English Ivy, Lesser Periwinkle, Yellow Lamium and Common Carp (*Cyprinus carpio,* also known in English as koi), thereby creating potential ecological and economic problems that may grow ever bigger as people prepare to hand their home place on to the next generation. For example, in west Qualicum Beach, a new road expanded the distribution of an unknown number of species including Couchgrass (*Elymus repens*), Scotch Broom (*Cytisus scoparius*), the European Black Slug (*Arion ater*) and the Great Grey Slug, also known as the Leopard Slug (*Limax maximus*), all native to Europe. As a result of these arrivals, gardening, horticulture and opportunities for commercial vegetable production suddenly became more difficult and costly, and less economically viable.

In the USA, "4,500 nonnative species have established free-living populations, of which about 15 percent cause severe harm; looking at just 79 of those species, the OTA documented $97 billion in damages (US congressional Office of Technology Assessment, sited in Quammen, 1998)."

On the Englishman River estuary, well meaning people have planted packets of "wildflower" seeds that are native to California and the Ukraine but not native to Vancouver Island. Governments have introduced, or allowed the spread of, mixed-breed geese that do not seem to migrate (Campbell et al., 1990; Dawe, 2004, pers. comm.; Clermont 2009, pers. comm.). Domestic cats, whether they are pets or feral animals, roam the estuary. For centuries, songbirds have traveled hundreds of kilometres to nest on Vancouver Island which, until recently, had no small feline predators, neither Lynx nor Bobcat. Do the songbirds nesting on Vancouver Island have behaviour patterns suitable for avoiding the hunting styles of a small feline predator?

Thus, the Englishman River estuary, with its rare natural ecosystems and invasive species, is a microcosm of this issue which is both island-wide and global; some examples will be discussed below. This project undertook to list the invasive species encountered, map the distribution of selected species within the study area, research and experiment with some control measures, and report findings and recommendations in an annotated list that prioritizes the invasive species seen based on the severity of the problems likely to be associated with them. Our objective was to contribute to realistic long-term planning that is specific to each invasive species and the location of its occurrence.

5.2 Invasive Species Mapping Methodology

The UTM coordinates of selected non-native vascular plant occurrences were recorded by trained volunteers onto a GPS unit (either Garmin etrex Legend or Garmin etrex Summit). The data from this was downloaded and mapped using ArcView 3.1 onto 2007 colour orthophotos (.tif format) for use at scales of 1:10000 to 1:300. For Scotch Broom, the distribution was determined by a combination of GPS-recorded occurrences and orthophoto interpretation of broom plants. The map of Scotch Broom distribution on the estuary (Map 2.3) shows these two forms of data separately to inform users about the accuracy of the points being shown. For English Ivy, which can be seen in trees at a distance, most occurrences were recorded using a GPS, but some locations were mapped by recording the approximate locations in relation to some landmarks that were later located on the 2007 orthophotos. Other non-native plant maps are based mostly or entirely on GPS field data. The range maps of invasive species were used to develop recommendations for management. To help with discussion and planning strategies, the broom management plans are area-specific through reference to broom management zones (Broom Zones A to H).

A list of invasive species observed during this study on the Englishman River estuary is provided in Appendix 2.3. Below is an annotated list of some of the observed invasive species arranged in a sequence from high to low priority; the species that seemed to present the most serious threats to native species and ecosystems on the estuary are at the top while those species that appear to be less threatening are nearer the bottom. Invasive species information and rankings from many sources were taken into consideration, but also the purpose of the ranking; a plant that is considered noxious or "invasive" in a farmer's field which is perpetually maintained in the early seral stage typical of modern agriculture may be a minimal threat within an established estuary ecosystem. The origin of some species that are present on the Englishman River estuary, such as Stinging Nettle (*Urtica dioica*), may be controversial. Another example, Saltmarsh Dodder (*Cuscuta salina*) is present in the study area; it is considered a native species in this report, based on E-Flora of BC (2009) and Wikipedia (2009), even though there may be some controversy about this.

Non-native species that have an observable impact on native ecosystems are ranked a higher threat than those that do not yet present impacts. In this report, the shade tolerant non-native species are considered a higher threat to native species and ecosystems in the forest than are early seral species that only live for a few years on freshly disturbed ground in open areas. A non-native species that has been present for decades and appears to have reached a stable population

and distribution on the study area will be ranked as a lower threat, if all other factors are equal. Non-native species that are known to do well and spread quickly in this climate are considered a greater threat, and so on. Species native to Vancouver Island are not considered a potential threat unless there has been some kind of genetic or behavioural modification, as is the case with the Canada Goose and Reed Canarygrass, for example.

In Appendix 2.3 can be found a list of some vascular plant species or taxa introduced to Vancouver Island that were observed on the Englishman River Estuary during 2007 and 2008.

5.3 Annotated List of Some Invasive Species Observed on the Englishman River Estuary, 2007 and 2008

5.3.1 Overview

The purpose of this list is to help with a 6-step planning process for volunteers, land managers and for the Mid Vancouver Island Habitat Enhancement Society.
For each species:

1.) Know the subject species and its ecology. This will give clues about management options.
2.) Know its distribution in and around the estuary, and how long it has been there.
3.) Catalogue some techniques tried or observed; include details of what, where, when, why?
4.) Prioritize the work from first experiment to final outcome, then make a plan and act on it.
5.) Record results. Scientific methods of testing techniques give understandable and replicable results. If the testing appears a success, volunteers are likely to feel encouraged. If the testing shows a failure, it allows another, more refined attempt a through an adaptive process.
6.) Make further recommendations to modify the plan for controlling the invasive species and build a deeper relationship with partners.

The following annotated list of invasive species is not intended to be comprehensive. A more complete list of invasive species observed on the estuary is presented in Appendix 2.3. More species will be added to the list as new ones are found and as new species invade the area.

Each category is presented in approximate order of suggested priority; this same sequence is used in the annotated list below.

Shade-tolerant Invasive Plant Species of Forests and Forest Openings

(1) Lesser Periwinkle (*Vinca minor*)
English Ivy (*Hedera helix*)

Common Touch-me-not (aka Jewelweed or Impatiens) (*Impatiens noli-tangere*)

Yellow Archangel - variegated form (*Lamiastrum galeobdolon*)

Herb Robert (aka Robert Geranium) (*Geranium robertianum*)

Spurge Laurel (*Daphne laureola*)

European Holly (*Ilex aquifolium*)

Shade-Intolerant Invasive Shrubs and Trees

(2) birch (*Betula spp.* likely European White Birch, *Betula pendula*)
Scotch Broom (*Cytisus scoparius*)

Armenian Blackberry (aka Himalayan Blackberry) (*Rubus armeniacus*)

& Cut-leaf Evergreen Blackberry (*Rubus laciniatus*)

Salt-tolerant Invasive Plant Species of Brackish and Saline Marshes

(3) Creeping Bentgrass (*Agrostis stolonifera*)

European Saltwort (aka Common Glasswort, S*alicornia europaea* aka *Salicornia depressa*)

Brass Buttons (*Cotula coronopifolia*)

Couchgrass (*Elymus repens aka Agropyron repens, Elytrigia repens)*

Shade-intolerant Early Seral Plant Species

(4) knapweed (*Centaurea spp.* likely Spotted Knapweed, *C. maculosa* aka *C. biebersteinii*)

Canada Thistle (aka Creeping Thistle, *Cirsium arvense*)

Bull Thistle (*Cirsium vulgare*)

Common Tansy (*Tanacetum vulgare*)

Purple Deadnettle (aka Purple Lamium, (*Lamium purpureum*)

Some Other Non-native Plant Species

(5) Field Bindweed (*Convolvulus arvensis*)

(6) some buttercups (non-native *Ranunculus spp.* such as Creeping Buttercup, *Ranunculus repens*)

Early Hairgrass (*Aira praecox*)

(7) Perennial Sow-thistle (*Sonchus arvensis*)

Some Non-native Animal Taxa (Species, subspecies and crosses)

(8) European Black Slug (*Arion ater*)

Canada Goose (*Branta canadensis*), the non-migratory cross variant

Ring-necked Pheasant aka Common Pheasant (*Phasianus colchicus*)

California Quail (*Callipepla californica*)

(9) Barred Owl (*Strix varia*)

(10) European Starling (*Sternus vulgaris*)

House Finch (*Carpodacus mexicanus*)

Eastern Cottontail (*Sylvilagus floridanus*)

Domestic Cat (*Felis catus*)

Domestic Dog (*Canis lupus familiaris*)

Human (*Homo sapiens*), the industrialized cultural variant

Some Non-native Species To Prepare For

These species were <u>not</u> observed on or adjacent to the estuary in this study, but are known to occur in the area.

- Chervil or Wild Chervil (*Anthriscus sylvestris*)
- Giant Hogweed (*Heracleum mantegazzianum*)
- Great Grey or Leopard Slug (*Limax maximus*)
- Grey Squirrel (*Sciurus carolinensis*)

5.3.2 Shade-tolerant Invasive Plant Species of Forests and Forest Openings

Lesser Periwinkle (*Vinca minor*)

Lesser Periwinkle is present on the study area for a stretch along Plummer Road from the large Western Redcedar (*Thuja plicata*) shrine for Neil Robert Murison in the south to the roadside ditch just north of the main trail into the Plummer Road Forest. Periwinkle is a highly invasive ground cover from Europe that spreads vegetatively by above-ground trailing stems. Severed stems can root easily. Its evergreen leaves are vaguely reminiscent of English Ivy but, unlike the ivy which grows nearby, periwinkle does not climb. In spring, its showy periwinkle-blue five-petaled flowers are unmistakable. Because it is tolerant of shade, periwinkle could easily become a permanent part of the forest floor on southeastern Vancouver Island to the exclusion of many native species. In this study, periwinkle was observed competing successfully with a number of native species including Vanilla Leaf (*Achlys triphylla*) and Fringe Cup (*Tellima grandiflora*).

The authors consider this species to be of the highest possible concern and recommend immediate removal with the goal of eradication. Plummer Road is the only known occurrence in the study area; it is an area where the native vegetation is already impacted by invasive species and human recreational use of the narrow riverside strip. The advantage of this is that, although pulling of periwinkle will disturb the soil, this will likely have minimal impact the ecosystems present.

The river itself seems to provide a barrier to the spread of periwinkle but that is an illusion; one stem of periwinkle broken off on Plummer Road and tossed into the river might have a fair chance of landing on Big Island where it could easily root and create a severe impact on the intact native ecosystems there.

We recommend experimentation with hand pulling coupled with careful record keeping so that the most efficient method of removal can be identified. Everyone would need to be informed of the importance of not spreading the broken stems anywhere, especially not in the river. The plant contains vincamines which have some human metabolic effects. Hand washing after hand pulling is important, and the periwinkle plant parts should be meticulously removed for shredding and composting rather than attempting to dispose of them by dumping or burning.

English Ivy (*Hedera helix*)

English Ivy, also known as Common Ivy, is present in a few locations on the estuary. However, in contrast with broom and blackberry which are shade-intolerant and generally dependent on disturbance, ivy can spread and become dominant within a mature forest, even a mature (Structural Class 6) riparian forest. For example, near the mouth of the Sooke River there exists an occurrence of what appeared to be a Douglas Fir - Salal forest several hundred years old. It might have been classified as an occurrence of a RED-listed ecosystem but the ground and the tree trunks were so overgrown with thousands of square metres of English Ivy that the native plant community was almost unrecognizable. For this reason, the presence of English Ivy on the Englishman River Estuary is an acute threat to native ecosystems.

The good news is that the occurrences on the Englishman River estuary appear to be spreading slowly and their total number and size allow them to be managed immediately for containment. The goal with ivy on the Englishman River Estuary should be complete eradication of this serious invasive species as soon as possible. Even for a volunteer group, and especially with the help of paid labour in the summer, there seems to be a reasonable expectation of success.

Ivy is both a ground cover and a climber, which in one area of the estuary has achieved 50 to 100% coverage on the forest floor and a high percent cover in the canopy. It climbs with use of sucker-like pads comprised of aerial rootlets. Ivy has two types of leaves, the familiar palmate 5-lobed "juvenile" leaves of the climbing vines and the "mature" leaves associated with the black clusters of berries. The leaves and stems contain biologically active chemicals which have medicinal and toxic qualities that should not be carelessly ingested or breathed as smoke. Gloves are recommended for handling. Each person working with ivy should take care at first to see if they have any reaction because "The leaves can cause severe contact dermatitis in some people." (Jøhnke, H & Bjarnason, B. (1994). and Boyle, J. & Harman, R. M. H. (2006) cited by Wikipedia, 2009) Disposal of cuttings by fire is probably not a safe option unless a facility is available that allows special precautions to vent the smoke.

The largest occurrence is on the Big Island near an area that ranks as one of the oldest and most undisturbed natural forest areas on the entire estuary. Seven large tree trunks (3 trees were approaching one metre diameter at breast height, approximately) were found to be completely covered by ivy stems. The ivy stems were overlapping on the trunk three or four layers deep for a total of up to 20 centimetres so that no part of the tree's bark was visible near the ground. The largest ivy stems were over 10 cm thick and, if the annular growth rings on ivy are annual, the ages of the largest stems were more that 50 years. The growth of ivy leaves on these trees could easily be seen as part of the forest skyline from 300 metres away. Uncounted smaller trees and shrubs were also supporting a mass of ivy and there was at least 700 square metres of ground surface completely covered by living ivy leaves. Two other separate, relatively minor, ivy occurrences were found on the Big Island, one on the west side near the main channel of the river and the other in the heart of the forest.

Another large occurrence of ivy involves 7 tree-trunks between the east bank of the river and Plummer Road. A few plants can be also be seen beside the forest perimeter trail where it passes the straight-sided pond near the Mills Road entrance.

With the concerted effort of four men over 3 days at the worst infestation on the estuary, the ivy stems were completely removed from the seven largest trees. The tools used were machete, sharpened mattock, long-handled loppers with a compounded mechanical advantage, and hand pruners. It was thought that a chainsaw would be more likely to damage the tree and be a danger to the removal crew, if not from accident, then from exhaust fumes, hand vibration and noise. From the other two outbreaks on Big Island, all upright stems of any size were cleared of ivy. A month later at the site of the most dense occurrence, thousands of ivy leaves had fallen from high in the conifers that had been cleared of ivy stems. This created an unexpected windfall -- a layer of mulch 10 to 20 centimetres deep which appeared to be suppressing the layer of living ivy that had been covering the ground surface beneath the infested trees.

Another goal of anyone working on the ivy problem (or invasive species in general) could be legislative change. Volunteers and paid students that had been returning for several days of physical labour at the most ivy-dominated site to rescue some of the largest Douglas-firs on the estuary, decided to take a lunch break in Parksville. At the shop, ivy in small pots was on sale - special that day. The sale or import of English Ivy is banned in Oregon, and it is on the list of noxious weeds of 45 other states of the USA. (USDA, cited by Wikipedia, 2009). We will probably be battling to save native ecosystems on Vancouver Island from ivy for many decades to come - it is time we stopped planting and cultivating it.

Common Touch-me-not (*Impatiens noli-tangere*)
Common Touch-me-not, also known as Jewelweed or Impatiens, is an annual, possibly from Eurasia. The only known occurrence near the Englishman estuary is from one backyard adjacent to the waterline right-of-way trail on the southern edge of the estuary study area. This species had been very successful in conditions similar to the Englishman Estuary, such as throughout Burnaby Lake Regional Park on the Lower Mainland in the early 1980's, where it sometimes dominated a solid 100 square metre area of ground. It spreads by seeds dispersed by a spring-like mechanism in the ripe seedpods. Unfortunately for those trying to prevent the spread of this serious invasive species, the seedpod-popping is a dramatic tactile, auditory and visual experience which can be almost irresistible to children (and adults).

Touch-me-not is not established on the Englishman River estuary and so the management plan for this species would be monitoring, education and various actions to prevent that from happening. With the cooperation of adjacent landowners, and a few years of pulling these rather frail plants before they seed, a buffer zone free of Touch-me-not could be established and kept completely clear of this species.

Yellow Archangel - variegated form (Lamiastrum galeobdolon)
A wild form of this sprawling, soft-bodied forest plant in the Mint Family is common in Europe (Wikipedia, 2009). It is sometimes known as Yellow Lamium even though it is no longer classified in that genus. Spreading easily by runners, as well as by abundant seed production, Yellow Archangel, with its showy yellow flowers from April to June, has become a popular ornamental groundcover in gardens and yards on Vancouver Island and the Lower Mainland. Yellow Archangel occurs on the southern edge of the Englishman River estuary, on the waterline right-of-way and in the adjacent forest, near the forest edge. Dumping sites for garden trimmings and yard waste were observed there in 2007, so it is likely that it escaped from a similar source at some time in the recent past.

This species has various forms or cultivars, and all are serious threats to native ecosystems on Vancouver Island. The form on the Englishman estuary has leaves that are bright green but dominated by obvious large white blotches known as variegated. This form has covered some forested creek bank areas from Nanaimo to Qualicum Beach. A similar form has become one of the top six priority invasive species in Surrey, B.C. and control strategies are being developed in Coquitlam and Langley (Evergreen Invasive Plant Profile, 2009). The same species, but a different cultivar, is a serious pest in the Seattle area.

Removal is recommended immediately to stop vegetative spread, and each year thereafter before seeds are produced. Since the species is just getting established on the estuary, the aim should be eradication combined with education of neighbouring residents. Removal techniques usually involve some kind of hand pulling, often with a rake. Evergreen Invasive Plant Profile (2009) warns against trying to compost this plant material because it can grow in the composter. It is important to be careful to avoid allowing stray plant parts to root, but composting can be achieved using a power mulcher, lawn mower or machete to chop the soft plant tissues before composting in black plastic bags or garbage containers placed in an exposed location so solar energy helps to warm it and compost it. Even some haphazard chopping or breaking of the tissues creates more infection sites for bacteria and fungi so that the plant tissues cannot survive a period of warm incubation.

Because the plant is so popular, it may be effective to develop a package of suggestions for alternative groundcovers that can be used locally. The Evergreen Invasive Plant Profile (2009) suggests *Tiarella trifoliata*, *Hosta spp*., *Euonymus fortunei*, *Epimedium spp*., and *Oxalis oregana*.

Herb Robert (*Geranium robertianum*)

Herb Robert, a native of Eurasia, is common on the Englishman River estuary, primarily in forested areas near openings or stream banks, where there is sufficient moisture and nutrients and shade. A taprooted annual (Pojar and MacKinnon, 1994) with the option of biennial growth, Herb Robert seems to spread by relatively large seeds, which germinate easily in this climate, often producing an carpet of crowded seedlings. Only a few of the seedlings seem to make it to maturity each year. Herb Robert is listed as blooming from April until the autumn but, on the Englishman Estuary, it was observed to bloom in almost every month of the year. It is unknown if viable seeds were produced from flowers during cold months.

This showy flower has been so fully naturalized for such a long time in some areas of North America that several states in the USA claim it as a native plant. On Vancouver Island, it is still expanding its range; the authors noted its arrival in west Qualicum Beach with the expansion of the road network into an otherwise undeveloped area.

As a shade-tolerant species, there appear to be no barriers against it becoming the dominant ground cover in suitable areas of the estuary; it was observed competing successfully with some native forest forbs like Siberian Miner's Lettuce (*Claytonia sibirica*) and Foam Flower (*Tiarella trifoliata*). In the State of Washington website for plant communities, Chappell (2006) states that Herb Robert "is another threatening non-native because of its potential impacts on the forb layer" within certain endangered forested plant associations similar to those occurring on the Englishman River estuary (such as Western Redcedar-Grand Fir-Sword Fern). To accept Herb Robert (or any invasive species) as fully naturalized on Vancouver Island and therefore beyond the scope of control measures might be a decision to accept extirpation of one or more native species on the Englishman estuary and on the whole of Vancouver Island.

The first step in developing a realistic management plan would be to map the distribution of Herb Robert on the Englishman River estuary. Pairs of volunteers could do this using the GPS-to-computer methods developed in this project. A management plan might include either control or eradication from the estuary, or from part of the estuary, based on how difficult it is remove the plants. A quick trial of hand removal from a small area showed that the roots of the adult plants come out easily and completely, it seemed. If it is true that the seeds germinate easily, this could be an advantage for control because there is not likely to be a large seed bank present in the soil. It would be useful to design careful experiments to compare different methods of hand pulling and in particular the timing - is it better to pull the numerous little seedlings in spring or to pull fewer plants later when they are mature? If a suitable method can be developed, the initial management objective might be to prevent extirpation of those species with which Herb Robert competes, and to eliminate Herb Robert from one area, such as Big Island on the Englishman River estuary.

The plant has a long history of uses to humans, including as an effective mosquito repellent (Pojar and MacKinnon, 1994; Wikipedia, 2009); perhaps harvesting for some purpose can be encouraged. Experienced naturalists could be pulling it as they encounter it. At the very least, we recommend that care be taken to avoid spreading it. In the state of Washington, it is known as Stinky Bob because of the distinct geranium smell and it is legally classified as a noxious weed. We would recommend that anyone concerned about this encourage the governments of British Columbia and Canada to follow suit by adding it to their lists of legislated weeds.

Spurge Laurel (*Daphne laureola*)

Spurge Laurel is a small evergreen shrub native to Europe including England. It has glossy, leathery leaves and black berries in late summer. Its leaves tend to be whorled around the end of each branch and the berries under them, giving young plants an overall shape that is vaguely reminiscent of a coconut palm tree, although the leaves and stems do not look like palm. Spurge laurel is tolerant of sun but it thrives in shade; this and its ability to spread by seeds in the berries

and by suckers makes it a serious threat to the native forest ecosystems of Vancouver Island. In Washington State, USA, it is classified as a noxious weed (Wikipedia, 2009). On the Englishman River estuary, it has a scattered distribution throughout the forest and shrub areas but over time as the density and abundance are likely to increase, the occurrences may coalesce forming stands that are nearly monospecific, such as occur in Qualicum Beach. Control is possible by hand pulling but care must be taken to wear gloves because the plant tissues contain toxins and caustic sap. Wikipedia (2009) suggests that plants too large to pull, can be cut off at or below the ground level.

European Holly (*Ilex aquifolium*)

European Holly is a non-native shrub or small tree that is well established in the Parksville - Qualicum Beach area, probably because of escapes from commercial holly farms where for the prickly evergreen foliage with red berries is grown to to meet the demand at Christmas, and for the hard, white wood which is used for piano keys, chess figures, wood inlay and many other uses. Holly is common on the Englishman River estuary, but occurrence is scattered throughout the forest areas and forest edges because its main form of dispersal seems to be through consumption of the berries by birds. However, under a mature berry-producing bush there may develop a jungle of 50 to 100 young holly saplings.

European Holly grows well in the temperate areas of Australia, New Zealand and western North America and every case it is a concern as an invasive species. It is shade tolerant, which makes it a serious threat to native forest ecosystems on Vancouver Island however, its abundance and growth rate tend to be low so the threat is not as acute as some other species. Nevertheless, its removal is recommended, initially by cutting it when time and resources permit. At times when the wood has economic value, it might be possible to find a commercial collector who will exploit it with the goal, not of managing it, but of extirpating it from the estuary.

5.3.3 Shade Intolerant Invasive Shrubs and Trees

Birch (*Betula spp.*)

A patch of more than 20 birch trees (*Betula spp.*), likely European White Birch (*Betula pendula*) or a cross, occurs near Mills Road on the southern edge of the estuary. A few of them, those with the trunks roughly 20 centimetres in diameter, have bright white bark that peels horizontally in fine layers. Female catkins are 2 to 2.7 cm long and 0.6 to 0.8 cm wide. The male catkins are longer, approximately 4cm long, but narrower, only 0.3 cm wide. The leaves are not hairy or glandular; they are approximately 3cm X 4.5cm with a petiole that appears to be always less than 1 cm long. Many of the finer twigs appear pendulous; some more so than others. The species most like this description is *Betula pendula*, however many of the species of *Betula* hybridize freely, which might account for the differences in form as seen from a distance.

These birch trees appear to be thriving and spreading on the Englishman River estuary. Pojar and MacKinnon (1994) list no native birch trees on Vancouver Island, however E-Flora of BC (2009) shows occurrences of both *Betula papyrifera*, a BC species that is not native to Vancouver Island, and *Betula pendula*, a native from Europe which is an invasive species in BC but available in nurseries because of its beautiful pendulous branches. Both species are invasive on the Englishman River estuary. Brayshaw (1996) reports that the European White Birch is "now escaped and becoming abundant on the Lower Mainland and to a lesser extent on southern Vancouver Island; now the commonest birch on the Fraser River delta." The removal of all birch trees from the estuary is recommended as soon as possible. However, further research and experimentation is advised to see if anyone knows what is the most effective way to do this without regrowth from the stumps (coppicing). For example, is it better to cut the stumps or girdle them, and what time of year is best? Copper nails might be effective against coppicing under certain conditions, but care must be taken to avoid any unwanted side effects.

When undertaking control of the birch, care and skill at identification is required. Even experienced people can confuse the bark of birch with the native tree, Bitter Cherry (*Prunus emarginata*) which is present in the same vicinity on the estuary. The colours and lenticel patterns of the two species can be similar. Ideally, a person experienced in tree identification on Vancouver Island would go through first and flag all the trunks to be cut and this would be checked by someone else, before any cutting begins.

Scotch Broom (*Cytisus scoparius*)

Scotch Broom is a native of Europe. It has gained a high profile as an undesirable species since its introduction to Vancouver Island in 1850 in the form of 3 seeds from Hawaii that germinated. "Broom has been so successful over much of its (new) range that it has endangered much of our region's distinctive rainshadow flora." (Pojar and MacKinnon, 1994). In the Parksville - Qualicum Beach area, a "Cut Broom in Bloom" campaign was started by the "Broombusters" in 2006 (Murdoch, 2008); it is a popular broad-based community project that involves many different groups and hundreds of individuals as well as volunteered resources, including an entry in the Qualicum Beach Family Day parade to promote awareness.

However, letters to the editor in the local newspapers have hotly debated the desirability and effectiveness of broom control. Although a large segment of the public is aware of broom related issues, there still seems to be much misinformation.

Like many rugged plants, broom has alkaloid poisons in its branches, leaves and seeds (Pojar and MacKinnon, 1994). It is toxic to humans and livestock and burning of any broom tissue is not recommended, especially where inhalation of smoke cannot be avoided. It can produce 10,000 seeds per plant and the seeds may last in the soil for 5 to 60 years (King County Department of Natural Resources and Parks, 2004?).

Broom distribution and abundance on the estuary seems to be related to three factors: shade, saltwater and soil disturbance. Broom appears stressed and unlikely to succeed in places with shade from a canopy above it, or where soil moisture is high, especially if the roots are exposed to brackish or salt water. Broom appears to survive and compete successfully in open locations on disturbed soils , even if nutrients are low and drainage is rapid, such as on gravelly or sandy deposits where summer drought can be severe. Broom seems to thrive as an early seral stage on gravel and sand with a freshwater table nearby, such as on gravel bars and other areas of recent deposition on the river's floodplain.

Its ability to thrive on poor soils is, in part, due to the symbiotic relationship it has with nitrogen fixing bacteria concentrated in nodules that are easily visible on the roots. The plant tends to hold most of the nitrogen it fixes in it tissues so the branches, leaves and roots all make effective compost material, especially if they are shredded or chipped.

Scotch Broom appears to have reached its potential peak in abundance and distribution on the Englishman River estuary. It was already a major component of several plant communities in 1976, based on plant community descriptions from Kennedy (1982). Today it appears in almost every location where it can survive. The mapping shows that attempts to prevent its spread would have little effect at this time.

Figure 5.3.3 Distribution of Scotch Broom, 2008.

Leaving Scotch Broom in its current state of abundance might continue to accumulate undesirable effects such as:

- the gradual degradation of native plant communities and the displacement or loss of native species that are currently struggling to compete with it, such as those species that would normally be associated with Dunegrass or Nootka Rose.
- the increased difficulty of restoring native vegetation on sites with broom.
- the potential for creating or increasing a long-lived broom seed bank in the soil
- possible fire hazard

From an understanding of the ecology of Scotch Broom, different strategies for ongoing management or eradication can be developed specific to each situation where broom is found on the estuary. Much information is available. The key is careful planning of the limited time and resources and then an unbiased evaluation of the success or failure of each technique so that, through adaptive management, the effectiveness of broom control can be increased over time. After mapping the distribution of broom on the estuary, it was possible to identify eight different Broom (management) Zones to assist campaigners to plan a strategy to suit each situation.

1) raised islands and fingers near tidewater
2) sandy beach and sandspit communities including accretion areas near tidewater
3) mixed shrub and graminoid areas between forest and marsh
4) areas of natural succession on ground recently deposited by the the river
5) forest, forest trails and forest clearings
6) disturbed areas around towers and kiosk, dykes and the 'Levee' on Big Island
7) buffers around edge of estuary
8) the shrub and graminoid area alienated by the Mine Road Dyke

We recommend that each campaign to control broom be specific to a location (or broom management zone) and that time and space be allowed for some scientifically designed experiments or test plots that compare some of the methods available to volunteers and managers. Much can be learned about broom control through careful experimentation.

We recommend that the objectives of broom control on the estuary be focused first on those areas with two characteristics:

1) the greatest benefit to native plant communities
2) the highest likelihood of eradication, if available resources and effort is focused

This would provide the best return for effort and it has the potential of providing some much needed victories for those volunteers who have been working on this problem year after year.

With the objective of getting the most ecological benefits in return for our efforts and, at the same time getting the best likelihood of eradication in one area at a time, we recommend three Broom Management Zones to become the top priority for broom control on the estuary:

Zone A - raised islands and fingers near tidewater
Zone B - sandy beach/sandspit communities including accretion areas near tidewater
Zone C - mixed shrub and graminoid areas between forest and marsh

Each broom management zone is considered separately below.

The task of a restoration project in any of these areas would be to make sure that appropriate native species were present to replace the void left by the broom. Cutting the broom can help the existing vegetation compete successfully. If the native species that can compete (mostly shrubs)

are absent or if the broom is going to be dug up or pulled for some other reason, we recommend planting with the appropriate native species for the zone under consideration. Some native species that compete with broom under estuarine conditions are:

Pacific Crabapple	*Malus fusca*
Nootka Rose	*Rosa nutkana*
Black Hawthorn	*Crataegus douglasii*
Tall Oregon Grape	*Mahonia aquifolium*
Dunegrass	*Leymus mollis*

Broom Zone A - raised islands and fingers near tidewater

On the little islands of high ground in the estuary, the broom is often under physiological stress. Annual cutting while the broom is in bloom would likely push the competitive advantage towards native species within a few years, as long as the native species were not damaged in the process of cutting the broom. This could be a quick job with big returns, but it would require some agility; the islands are often steep and the terrain is rough and unstable because of overhanging edges. After the first repetition of the cutting process, we would recommend an evaluation of the project the following year to see what comes back.

Among the shrub fingers on the west side of the estuary (Broom Zone A), the rose and other native shrubs are often so dense that it would be very difficult to cut the broom. A motorized blade would be effective at the edges and a long handled pruner can be used horizontally to some effect. In the centres of these thickets, beyond where it is easy to cut, the options of building trails for crawling through the rose to attack the broom might be self defeating because the disturbance, although killing broom plants, would also create improved broom habitat. Unless a method without disturbance can be devised, we suggest cutting the broom at the edges and simply monitoring the areas in the centre for a few years to see if the broom is succeeding under conditions where they are crowded by native species like Nootka Rose.

The salinity of the soil in the western marsh areas has increased since the dyke was breeched in 1979. In some marginal areas the broom is already dead or in decline. It is likely that the broom cover in some of those areas will continue to give way to competition from more salt tolerant native shrubs.

Broom Zone B - sandy beach and sandspit communities including accretion areas near tidewater

The broom on the sandspit and beach area on the east side of the river mouth (in Broom Zone B) was recently cut (2008); this might have been part of the work of a paid crew of young people employed by Nature Trust of BC. Their efforts seem to have released some parts of the sandspit habitat from shading and crowding by broom. The broom was not thriving there in any case, likely because of summer drought on the sandy soil, and because of salt from wave-spray and tidal water entering the pervious sandy substrate. Continuing to cut the broom each year can be expected to stress it further so that it will be replaced by native shrubs or shrub-like herbs such as Silver Burweed (*Ambrosia chamissonis*), and by Dunegrass (*Leymus mollis*).

The people cutting need to be informed of the fragility and rarity of that ecosystem, if they were not already. A thin skin of bryophytes (mosses and lichens) growing on the surface of loose sand dominates the vegetative cover and it is vulnerable to even a few careless, twisting or running footsteps. An evaluation of the 2008 broom control effort is needed that also considers any damages done, especially to the bryophyte layer. If this kind of evaluation guided training and preparation for a followup attack in 2009, the effort would likely show big results on the surviving broom because it is already under stress.

Broom Zone C - mixed shrub and graminoid areas between forest and marsh
The shrub and graminoid areas between the marsh and the forest support some large (300 square metres or more) stands of broom. As one moves towards the marsh, the broom is stressed similar to the situation in Broom Zone A. As one moves towards the forest, the broom is stressed by shade and other forms of competition (see description of Broom Zone E). If the stressed broom at either end of this gradient was cut (in bloom) one or two years in a row, it might never recover.

However, removal of broom from the large infestations of the intermediate area (between forest and marsh) would not likely be as easy. In spite of the size of the task, we recommend that broom removal from the intermediate areas of Broom Zone C (between the forest and the marsh) be a high priority for restoration because the broom there is in competition with, or has an adverse affect upon, many plant species in communities marked by Pacific Crabapple, Nootka Rose and Dunegrass.

In these intermediate areas where broom is a strong competitor, planting of native species will likely be needed to succeed. Planting and the associated disturbance of the soil creates the opportunity to dig the broom, roots and all; an option that is not recommended for Broom Zones A and B.

Conversely, if digging of broom is undertaken on any site, it is important that the disturbed ground be replanted with native shrubs as soon as practical. Pacific Crabapple is likely an effective first choice on natural sites near the forest especially on the Big Island in the estuary. It is unlikely that alder or conifers could be used to replace broom in open undisturbed areas like on the Big Island because the ecological conditions there seem unsuitable for them; alder and conifers would be growing there already if they could survive. Nootka Rose would be suitable for planting at the edge of existing thickets and in the shrub zone beyond the edge of the forest.

However, in the disturbed areas at the edge of the forest near the Shelly Road Viewing Tower, there are some areas where Red Alder would likely be the ideal species to plant to replace the broom that has been cut or dug. Alder might be able to grow and compete with cut broom on poor sites because, like broom, it produces its own nitrogen through a symbiotic relationship with soil bacteria. Once the alder, rose or crabapples get tall enough to shade the broom, it is expected that the last broom plants will die.

Strategies appropriate for broom control in areas where people (or the management plan) call for maintaining openness are discussed under Broom Zone F.

Broom Zone D - areas of natural succession on ground recently deposited by the the river
Unless the broom at the edge of the river is providing seeds for the re-invasion of areas downstream, Broom Zone D would probably be a low priory for broom removal. Gravel bars and low bench areas on the annual flood plain of the river are undergoing natural succession to forest without any help from humans. These areas seem ideal for broom right now, but as natural succession proceeds on this newly deposited ground, trees such as cottonwood and alder would get taller and the broom would decline, as can be seen on Big Island (photo #). Cutting the broom in these areas once would be helpful to hurry the succession and reduce the numbers of seeds dumped into the river, but repeated cutting would produce diminishing returns for the effort; we recommend this be a low priority for broom control and restoration dollars.

Broom Zone E - forest, forest trails and clearings
In the forest, the situation is similar to the river bench. Broom is virtually absent from old established native forest areas and it appears to be in decline where the native canopy has been reestablished . However, broom is present along old roads and throughout clearings in the forest.

Cutting the broom one or more times coupled with the planting of Douglas-fir has already almost eliminated the broom from one area. We would suggest planting Red Alder with the conifers because it provides faster growth to overshadow the broom and, like the broom, it fixes nitrogen so it can be a strong competitor for broom on poor soils.

Broom Zone F - disturbed areas around towers and kiosk, dykes and the 'Levee' on Big Island

A special management problem exists near the tower and kiosk and west along the edge of the forest. These areas appear to be open and shrubby because of disturbance. Broom removal has been done in some of these areas for years. If the management objective is to keep the area open around the tower and the junction of trails, a low growing competitor for broom needs to be found. We suggest continued cutting or, if the energy and tools are available, pulling and digging of the broom while planting Dunegrass among the stumps and disturbed ground. For those shrub areas closer to the forest, if the management objectives allow it, we would suggest continuing to pull or cut the broom while planting Nootka Rose, and in the areas closest to the forest, planting Red Alder and Douglas-fir. If the existing or planted trees look stressed, plant Pacific Crabapple, Saskatoonberry (*Amelanchier alnifolia*) or native Black Hawthorn (*Crataegus douglasii*). To avoid the similar, but invasive species Common Hawthorn (*Crataegus monogyna*), question carefully any nursery stock and refer to Pojar and MacKinnon (1994).

Those areas that are kept in grass and forbs by trampling of mammalian feet (people, deer, rabbits) should be left as is. In these areas, if broom sprouts, it is better to cut it that to dig it or pull it so that the ground with many viable broom seeds in it remains undisturbed as much as possible. In planning any land use, care should be taken to leave special features alone and unplanted if that is what is there now. Near the Shelly Road Viewing Tower there is a south-facing bare area where hundreds of solitary bees burrow and lay eggs creating a condominium of individual nests. Other barren locations around the estuary appear to be kept bare by many birds returning there to bath in dust. These areas are small but important to the ecology of the estuary so it would be unfortunate to destroy them in an effort to control broom, unless it is known that they can be easily and quickly replaced.

Broom Zone G - buffers around edge of estuary

The Sensitive Ecosystems Inventory Conservation Manual (McPhee et al, 2000) emphasizes the importance of buffers for a variety of purposes, including invasive species control. Suitable broom management buffers would include the roadsides and properties of Shorewood Drive and San Malo, including the 'bicycle park,' the roadsides and river edge along Plummer Road, around the highway bridge and the river side down to the Parksville Waterline Trail, the Parksville Waterline Trail including Shelley Road parking lot, forest and shrub areas from the north end of Mills Road to Golden Dawn facility, the west side of the estuary including Golden Dawn facility and the roads and filled areas near Surfside RV facility, the entire Surfside RV area and the beaches, walls and dykes that border it.

If part of the estuary study area gets cleared of broom, the adjacent buffer zones become very important, either as sources of seeds and future infestation, or as broom-free areas that can be maintained as such because they are already disturbed. The idea is that drastic measures like digging, ploughing, bulldozing or machine cutting of invasive species can be implemented in the buffer zones without hazard to the estuary ecosystems.

For example, near the parking lots and waterline trail on the southern edge of the Parksville Flats property, broom is in competition mainly with non-native grasses. The removal of broom and other non-native species (Armenian Blackberry, Comfrey, Common Tansy, Jewelweed, etc) along that edge is not a priority in itself. However, as a buffer zone removal of these species there becomes important because that is the gateway and the last line of defense against the introduction of those

species or the reintroduction of a species that has been eliminated from adjacent areas. Mowing is sometimes being done along the Parksville Waterline Trail and we recommend that be encouraged or reinforced as a way of controlling broom and other non-native species along that frontier.

Broom Zone H - the shrub and graminoid area alienated by the Mine Road Dyke

We recommend that the area that is protected from the influences of the river and tidal water by the Mine Road Dyke in San Pareil be a low priority for broom control measures. If the dyke is breeched (Summers and McKenzie, 1990) and the area becomes accessible to river and saltwater once again, the broom will likely die, as it did on the west side of the estuary. On the other hand, if the area is left as it is, natural succession will likely overtake the broom within 30 years, except at the edges: the roadsides, the backyards and on the dyke. If there is a shortage of time and energy and money, we recommend that this area be considered last for broom control. If an adjacent area is made broom-free, such as the dyke, then the area behind the dyke should be a considered a buffer zone (see Broom Zone G) and cleared of broom as time and money allow.

Permission Required
Note that some private property has been included in or near the broom management zones and buffers. Suggestions about broom control on private land are for discussion purposed only. Anyone planning broom removal on private land, including the Englishman River estuary, needs to obtain prior permission of the landowners.

Armenian Blackberry (*Rubus armeniacus*) & Cut-leaf Evergreen Blackberry (*Rubus laciniatus*)
Two species of non-native blackberry are present on the estuary. The Armenian Blackberry is commonly known locally as the Himalayan Blackberry, despite the fact that it originated in the Caucasus region (Wikipedia, 2009) and is a long-time resident of Europe and around the Mediterranean (Invasive Species Net, 2009). The Cut-leaf Evergreen Blackberry can easily be distinguished from the Armenian Blackberry by its deeply and finely cut leaves; the berries of Cut-leaf Evergreen Blackberry usually ripen in August-September whereas the Armenian Blackberries ripen in July- August, in most years. Both species are thorny perennial shrubs with stems that are thick and stiff rather than limp, they are usually elevated off the ground and often arching, and they are biennial. The first year stems produce rapid vegetative growth and the second year they bear fruit and usually die back.

The Trailing Blackberry (*Rubus ursinus*), a perennial trailing shrub native to Vancouver Island, is also present on the estuary. Its stems are limp, like string with thorns, and never more than a few millimeters thick, and the thorns of the invasive species are usually thicker than the whole stem of the native species. Nevertheless, care should be taken to distinguish Trailing Blackberry from its invasive counterparts because all three species of blackberries on the estuary have similar black fruits that consist of a compound structure call a drupe which, when picked, take the central support structure with them, attached to the berry. Other related native berries on the estuary such as Salmonberry (*Rubus spectabilis*) and Thimbleberry (*Rubus parviflorus*) have yellow or red (seldom dark) drupes (berries) that come off the parent plant with the central support structure attached to the fruit.

These species, especially the Armenian Blackberry, have been introduced to many parts of the world where they have become invasive pests. At the same time, their fruit is much valued and often collected and even celebrated in various harvest festivals by people unconcerned about the invasive qualities. On the Englishman River estuary, the Armenian Blackberry is more abundant than the Cut-leaf Evergreen Blackberry, but this may not always have been the case. Kennedy (1982) lists *Rubus laciniatus* as a dominant component of one of the plant communities that she

observed on the estuary in 1976; *Rubus armeniacus* /*Rubus discolor* is not mentioned.

Because of their long history and easy dispersal by birds, these two invasive blackberries have probably reached their peak in terms of abundance and distribution on the estuary. The first step in creating an integrated pest management strategy would be completing the inventory and mapping of these two species which was started by volunteers in this project. Removal by cutting with pruners or a motorized blade (or mowing with flail mounted on a backhoe or tractor, if budget allows), is recommended, but not as a high priority at this time. On farmland, goats tied to a tire will eat blackberries almost to the ground, but goats on an estuary is probably not an ecologically sound idea.

The largest numbers of these two invasive blackberry species occur behind the Mine Road Dyke. If the dyke is breached; they would be decimated in that area because they are not salt tolerant. On the other hand, if the dyke is not breached, they would likely fall into decline through succession because they are not tolerant of shade from forest trees and other shrubs.

5.3.4 Salt-tolerant Invasive Plant Species of Brackish and Saline Marshes

Creeping Bentgrass (*Agrostis stolonifera*)

Creeping Bentgrass is a native grass of Europe that appears to have naturalized in almost every province, territory and state of Canada, the USA and Greenland (USDA, 2009). It is popular for moist pastures and as a turf grass for short-cut lawns, and especially for the greens of golf courses, because it "aggressively produces horizontal stems, called stolons, that run along the soil's surface. These (characteristics) allow Creeping Bent to form dense stands under conducive conditions and outcompete..." other species of grass and forbs. (Wikipedia, 2009). The presence of stolons and long ligules helps to identify this species, but Pojar and MacKinnon (1994) point out some ambiguity in nomenclature; *Agrostis alba* is often used as a synonym for *Agrostis stolonifera* (see Kennedy, 1982) but *Agrostis alba* is also used as a synonym for *Agrostis gigantea* which has rhizomes but not stolons, and therefore occupies a different niche.

Creeping Bentgrass is almost ubiquitous on the brackish marshes of the Englishman River estuary down to the edge of the tidal channels. Under the name of Agrostis alba, Kennedy (1982) recorded its presence in 12 of the 19 plant communities she described on the estuary in 1976 and it was a dominant species in 4 of those 19 plant communities at that time. It is one of the few species that sometimes grows among the dense stands of Lyngbye's Sedge in the tall channel-edge community; as such it has invaded likely occurrences in the study area of CDFmm Em05 Lyngbye's Sedge Herbaceous Vegetation Ecosystem, which is BLUE-listed (BCCDC, 2008). Mackenzie and Moran (2004) state that Creeping Bentgrass "now forms the dominant component of the high marsh in many estuaries of the Georgia Depression."

Elimination or reduction of this invasive species from the study area seems unlikely at this time unless an insect enemy or a plant competitor arrives, but that could bring with it other unwanted impacts. On the contrary, it appears that Creeping Bentgrass may be going through another phase of expansion in response to grazing pressures from waterfowl. Creeping Bentgrass appears to be heavily grazed by the Canada Goose in the study area but ironically, the bentgrass appears to thrive under these conditions; it takes on the appearance of a golfing green while the other species that were competing with it disappear completely under the intense grazing pressure. To control the recent spread of Creeping Bentgrass, it would be likely necessary to control the Canada Goose, either its population or its use of the estuary.

European Saltwort (*Salicornia europaea* aka *Salicornia depressa*)

European Saltwort (also known as Common Glasswort) is a non-native annual species that is well established on the ERE. It typically has colonized areas on the ERE that have been left barren of plants by grazing, erosion, or a sudden change in salinity, as described by Dawe and McIntosh (1993). As a colonist and an early seral plant, it helps to stabilize bare ground but it gives way easily to later seral species such as Sea Milkwort and American Saltwort, a related perennial species in the same genus. No control measures are recommended for this species at this time. It is edible and considered choice but the process of collecting a sufficient quantity of this tiny plant without disturbing and eroding the vulnerable unvegetated substrate where it grows would be a challenge; collecting is not recommended.

Brass Buttons (*Cotula coronopifolia*)

Brass Buttons is a salt tolerant species native to South Africa but it has spread to shorelines in many places throughout the world. The tough leaves have a distinctive shape and the bright yellow rayless flowers can sometimes be seen at a distance. Its niche is as a colonist and an early seral plant often associated with European Saltwort at the edges of tidal channels and at the lowest edge of the middle marsh, often on surfaces where a substrate is exposed. It was not observed to be competing with any native vascular plant.

Brass Buttons may have arrived on the Englishman River estuary between 1976 and 1980; it is not mentioned by Kennedy (1982) and it appears as one of the first species that colonized the areas exposed by the die-off of salt intolerant species after the Shelly Road Dyke was breached in 1979 (Dawe and McIntosh,1993). The abundance and distribution of Brass Buttons appears to be expanding at this time in response to barren substrate created by intense waterfowl grazing pressures on the native vegetation. Therefore, the first step to controlling this expansion would be to control the impacts of grazing Canada Geese. No direct control measures are recommended at this time.

Couchgrass (*Elymus repens* aka *Elytrigia repens*; *Agropyron repens*)

Couchgrass is native to Eurasia and northwest Africa (Wikipedia, 2009) but it is a species many people are familiar with in gardens and on roadsides and almost anywhere in the world where European descendants have altered the landscape. Perhaps as a result, it has many names both in English (Quickgrass and Quackgrass) and in scientific nomenclature (*Elytrigia repens, Agropyron repens*). It is highly invasive on Vancouver Island; spread occurs easily by underground white rhizomes. Control is difficult in early seral situations such as gardens where digging and tilling often help to increase its abundance by destroying competition while breaking up the Couchgrass rhizomes so that each piece can form a new plant. Couchgrass competes successfully in open meadows, especially young meadows, but it is not usually able to withstand succession to a more shady situation; Couchgrass is not tolerant of deep shade.

On the Englishman River estuary, Couchgrass has been established for at least 30 years. In 1976, Kennedy (1982) named Couchgrass in 3 of the plant communities she described, including one where she considered it to be one of the dominant species. Today it occurs in the area from the shrub-to-meadow transition zone, where it grows in the open meadow patches between the groups of shrubs, down into parts of the high marsh where it appears to show some degree of salt-tolerance. Couchgrass on the study area sometimes presents as a monospecific patch of more than one hundred square metres. This indicates that it is likely suppressing some native species in, what would otherwise be, a species-rich habitat. It is unknown if the species is still expanding on the study area.

Partial control of Couchgrass can usually be achieved with impervious ground covers like black

plastic or plywood. Mulches of wood chips or straw can also control it if there is no opportunity for the grass to push up through the mulch but this is usually impractical because the mulch needs to be very deep and dense to have an effect. Control of Couchgrass is desirable from an ecological perspective but how to do this on a significant scale is not known. The first step would be to map the monospecific patches of Couchgrass on the estuary using the volunteer-based techniques developed in this study, and then monitor the patches over a period of years. If they are expanding, Couchgrass should be a priority for control and restoration; otherwise not. If the Couchgrass areas are shrinking, it might be a indication that later seral species have an advantage over Couchgrass if the situation remains stable enough for succession to occur. More research is urgently needed into ecological niche and distribution of Couchgrass on the estuary and what control measures used successfully elsewhere, but no control action is recommended at this time.

5.3.5 Shade-intolerant Early Seral Plant Species

Knapweed (*Centaurea spp.*)

Knapweed (likely Spotted Knapweed, *Centaurea maculosa* a.k.a *Centaurea biebersteinii*) is established on the Englishman River estuary south of the Shelly Road Viewing Tower in the vicinity, and east, of the kiosk sign. Spotted Knapweed is a biennial from Eastern Europe which can sometimes live more than 2 years. Several species of *Centaurea* can be serious invasive species on dry rangelands especially where overgrazing has reduced the viability of the native grass community, but its potential impact on the wet coast of B.C. is not known. Spotted Knapweed and some other *Centaurea* species are statutory (noxious) weeds under many legislative jurisdictions, including the Province of B.C.

The Arrowsmith Naturalists seem to have *Centaurea spp.* clear in their minds and their efforts to selectively hand pull it before it sets seeds each year seems to be an effective campaign strategy. If it ever happens that pulling does not occur before seed set begins, it is important to bag the pulled plants and mulch and compost in a secure manner to prevent the dead plants from setting seeds.

At first the campaign may seem to be limited to stopping its spread but eventually, assuming the level of manual control effort continues, it is expected that the seed bank will sprout and diminish over a period of up to 8 years and eradication will be achieved. Careful scientific monitoring of some sample plots of knapweed, might provide volunteers an incentive to continue because science might provide clear evidence of declining numbers of this species coincident with the Arrowsmith Naturalists' efforts at control. The Invasive Plant Council of B.C. (2008) warns that monitoring (and control, if necessary) should continue for several years after eradication seems to have been achieved.

Canada Thistle aka Creeping Thistle (*Cirsium arvense*)

Canada Thistle, in spite of the name, is an invasive species on Vancouver Island. The name Creeping Thistle is more descriptive of the way it spreads by long, white, underground rhizomes which can produce a new clonal plant at each node. Close inspection reveals that flowers can be male or female, and what looks like an area of ripe seed heads might actually contain little of no viable seed.

In 1976, this species was listed as present in 3 of the plant communities on the Englishman River estuary and it was considered dominant in one of them. Today the plant is able to thrive in the open near the Shelly Road Viewing Tower and kiosk and along some of the old dykes, but it also tolerates partial shade well, such as where the forest trails pass through an opening in the forest. Pulling the plant and digging the roots is difficult and usually counterproductive; the result is often more thistle plants than there were at the start because of regrowth from the rhizomes. However,

Creeping Thistle has a major weakness - it is intolerant of repeated mowing. A scythe or a motorized rotating line can be used to give other plants that are more tolerant of mowing, especially native grasses, a competitive edge over Creeping Thistle. Unfortunately, it often takes several mowings a year for several years to see success.

Bull Thistle (*Cirsium vulgare*)

Bull Thistle is a common biennial (or sometimes an opportunistic annual) in open disturbed areas and on old dykes in the study area where it can be an aggressive competitor for a short while after disturbance. However, it cannot survive succession processes for more that a few years so the density and abundance of this species appears to be stable. If management or restoration objectives require that an area be cleared of Bull Thistle, a scythe or a motorized rotating line can be effective if used to cut it off in the week or two before its flowers are open (usually in its second year of life). At that stage, the exposed interior of the hollow stem will often turn brown and rot right down into the taproot after it is cut. The cut stems do not seem to have the ability to re-root, but it can regrow from a healthy tap root. It is recommended that Bull Thistle be a low priority in an invasive species budget.

Common Tansy (*Tanacetum vulgare*)

Common Tansy is native to Eurasia where it is called simply Tansy, but the presence in BC of native species in the same genus requires a more precise usage here. Common Tansy is present mostly at the edges of the ERE where it appears to thrive but never in abundance. It appears as if the population of Tansy might be expanding. The tissues of Tansy are toxic and can cause contact dermatitis (and fatal poisoning if consumed in sufficient quantity) but these same toxins have made it useful as an insecticide and a de-worming medicine. The unforgettable strong smell of the leaves when crushed are described as "similar to that of camphor with hints of rosemary." in Wikipedia (2009). It is recommended that people familiarize themselves with this plant and pull it (with gloves on, for those with allergies or skin sensitivities) or cut it off whenever it is encountered and especially before it sets seeds. Because numbers are low, it may be possible to eradicate Common Tansy from the estuary.

Purple Deadnettle (*Lamium purpureum*)

Purple Deadnettle grows in a few open, well drained areas of the estuary, especially on parts of the old dykes. Its appearance is somewhat similar to Self Heal (*Prunella vulgaris*) but on Vancouver Island the flowers of Purple Deadnettle seem to be more pink than purple (see photo typical of Vancouver Island in Wikipedia, 2009). This species is invasive but it appears to have little chance of becoming a major threat to native ecosystems because it does not seem to tolerate forest shade or competition from taller plants on rich moist ground. It is recommended that Purple Deadnettle be a low priority for invasive species control budget at this time, unless the species is observed to be expanding. Therefore, inventory, mapping and monitoring is recommended using the volunteer GPS methods developed in this report. If a survey crew is doing inventory of this species, care should be taken to map Common Deadnettle (*Lamium amplexicaule*) separately; it is another non-native species with a somewhat similar appearance that might also be present on the Englishman estuary.

5.3.6 Some Other Non-native Plant Species

Bindweed (Convolvulus spp.)

In this study, only one occurrence of an invasive bindweed species was observed; it was on the east side of Mine Road Dyke, near the junction of the dyke and Plummer Road. By the size of its showy white flowers, it is likely Hedge Bindweed (Convolulus sepium). Immediate hand removal from the dyke is recommended to prevent the bindweed from getting established on the west side of the dyke. Pojar and MacKinnon (1994) note that a similar species, Field Bindweed (Convolulus

arvensis) is difficult to irradicate because of the deep rhizomes. A control plan for bindweed on the estuary would need to include a bindweed-free buffer in the adjacent backyards and for that, close cooperation with the adjacent landowners would be essential.

Buttercups (Ranunculus spp)
The invasive species Creeping Buttercup (*Ranunculus repens*) appears to be present on the estuary but confirmation of this was not a part of this study. In hindsight, it is recommended that it be a priority to key out the species of Ranunculus present on the estuary and then, using the people thus trained, map the distribution of Creeping Buttercup throughout the study area. A management plan would need to take into account the difficulty volunteers might have in distinguishing it from a number of native flowers on the estuary that are more or less buttercup-like such as Little Buttercup (*Ranunculus uncinatus*), Large-leaved Avens (*Geum macrophyllum*) and *Potentilla egedii*.

Early Hairgrass (*Aira praecox*)
Early Hairgrass is an abundant annual invasive grass in the high marsh and meadow areas of the Englishman River estuary. It is likely that it has fully occupied all of the locations (niches) suitable to it. Mapping and monitoring would be useful but volunteer GPS monitoring would probably be impractical due to the seasonal nature of this species and the difficulties with identification. It is recommended that this species be a low priority for control at this time.

Perennial Sow-thistle (*Sonchus arvensis*)
Perennial Sow Thistle (Sonchus arvensis) is a native of Eurasia that is now present in high marsh and meadow areas of the Englishman River estuary. It is one of the few plants that can become established and survive among a dense stand of Dunegrass (Leymus mollis). In 1976, Kennedy (1982) listed it as present in 10 of the 19 plant communities she used to describe the Englishman River estuary at that time, and it was a dominant or subdominant component of two of the plant communities she identified. It is classified as a noxious weed in the states of Washington and Alaska.

Because this invasive species spreads easily by wind and it has been present for at least 32 years on the study area, it is likely that it has already reached its peak of distribution and abundance on the estuary. As such, it can be considered s a low priority for invasive. It is recommended that no action to manage this species be taken unless it can be done without disturbing the soil or creating other undesirable impacts.

5.3.7 Some Non-native Animal Taxa (species, subspecies and crosses)

European Black Slug (*Arion ater*)
This species was observed near the suburban backyards on the southern edge of the study area and on Big Island of the Englishman River estuary. Its population on the estuary is likely increasing as it moves into new areas on the estuary. It is recommended that the options for management be researched.

Canada Goose (*Branta canadensis*)
The Canada Goose is a native species on Vancouver Island. However, in the 1940's, the species "was mainly a migrant and a summer visitant in British Columbia" (Campbell et al. 1990). At that time, few Canada Geese spent summer or winter anywhere in B.C. Counts of wintering birds in five locations around the Lower Mainland, including Ladner and Vancouver, totaled approximately 300 or fewer Canada Geese up until 1972.

The Canada Goose most likely to be seen on the Englishman River estuary at that time was probably one of three subspecies *Branta canadensis fulva*, *Branta canadensis minima* and *Branta canadensis occidentalis*, passing through, either in the spring on the way to its northern breeding

grounds, or in the fall while making the return pass through the area. Then, as now, large numbers of the Canada Goose are thought to have been migrating annually up and down the length of Vancouver Island, but mostly staying offshore on the west side of the island. At that time, relatively few Canada Geese visited the east side of the Island for any reason.

Seeing even one Canada Goose on the Englishman Estuary during the breeding season would have been unusual - likely a non-breeding bird. Bird counts done on the Englishman River estuary four times per month, from 17 June 1979 to 29 June 1980, created a record of all of the Canada Geese observed by the surveyors during a one year period. (Dawe et al. 1994). The first Canada Goose seen in that study was a single bird on 21 October 1979. Later, 5 birds were seen on 10 February 1980 and 8 birds were seen on 29 May1980. The Canada Goose was not seen at all in the summer months.

During the 1960's and 1970's, the most common behaviour seemed to be changing toward remaining year round in the same local area. Campbell et al (1990) note that the species has a high natural adaptability, but they consider the change in behaviour to be "primarily because of transplants of flightless young and breeding stock from a wide variety of races." The races of geese that were brought to the coast were not native to coastal British Columbia, so the larger form of Canada Goose that feeds and breeds on the Englishman River estuary today, and does not appear to migrate, is in effect, a non-native cross that has become an invasive "species" because its behaviour and its numbers are not in balance with the productivity of the estuary.

Instead of seasonal migration, during some parts of the year at least some of the birds engage in daily movements, often to farms, golf courses, parks and lawns during the daylight. During this study, flocks of Canada Geese were often observed arriving at the Englishman Estuary and other local estuaries in the twilight of dusk. Other geese with similar diurnal movement patterns, may be returning to freshwater marshes like Hamilton Marsh. During breeding, in April, May and June, many Canada Geese seem to remain with their young of the year on the Englishman Estuary around the clock. During the four to five week moulting period, possibly in July or August after breeding, the geese may be out on the Strait of Georgia to avoid predators while their feathers regrow (Maggie Little, 2009. pers. comm.) but these geese may be returning to the estuary at night to feed, preen, and sleep. In fact, this may be a period of heavy feeding because the geese need to eat much nitrogen-rich vegetation to replace the protein in the feathers that they have shed. In this study, we observed masses of goose feathers in the estuary, often on the tideline near the end of June 2007. The movements or migrations of the local Canada Geese might soon be better understood as observations accumulate of the leg bands that are being attached to Canada Geese by volunteers under the auspices of a Canadian Wildlife Service permit (Tim Clermont, 2009. pers. comm.).

The population of the Canada Goose appears to have grown exponentially in the Parksville - Qualicum Beach area since around 1980 or shortly thereafter (Neil Dawe, 2006. pers. comm.). The numbers of all the Canada Geese observed on the Englishman River estuary during one monthly bird survey along a regular route, usually between the hours of 9 and 11am, were recorded by the Arrowsmith Naturalists (2009) from March 2005 to February 2009. The highest number of Canada Geese counted on any one survey within each year is shown below; surveys seek to avoid counting the same bird twice so these numbers indicate that at least that many Canada Geese were using the estuary for some part of that year:

June 2005:	220 adults and 16 juveniles
June 2006:	85 adults and 0 juveniles
April 2007:	95 adults and 0 juveniles
December 2008:	194 adults and 0 juveniles
February 2009:	53adults and 0 juveniles

Although the Arrowsmith Naturalists had already undertaken counting the birds, some incidental observations of Canada Goose numbers were made as part of this study. Notably on 29 September 2008, approximately 109 Canada Geese were observed taking flight at the north end of Centre Marsh on the Englishman Estuary (photo). The numbers of goslings that hatched on the Big Island in 2008 appeared to be similar to the number of eggs (6, 7 , and 8) that had been observed in each of the 3 nests that were close to the vegetation work being done at that time. A fourth nest in an exposed location was also observed but its 6 eggs were all predated the day after some of the eggs were handled briefly to look for markings. Predation might have happened while the adults delayed returning to the nest after the human intrusion, or it might be the result of a predator such as a mustellid smelling human presence on the eggs (Clermont, 2009. pers. comm). Many other nests were encountered but no time was spent recording them or observing their degree of success. Clermont (February 2009, pers. comm.) clarified that they (Nature Trust) had not done egg addling in 2008 at that location.

On 19 April 2009, the number of nests observed by MVIHES volunteers on the Big Island of the Englishman estuary was 26 and an additional 5 nests were seen on the San Pareil High Marsh Finger, including the little islands in San Pareil Lagoon. Of these, a total of 7 nests had all unmarked eggs and 3 nests had some marked eggs and some unmarked eggs. The remainder of the eggs were marked, either as addled eggs or as cold eggs that should be addled once incubation starts and egg-laying stops. The Canada Goose is unlike many other waterfowl in that it is almost exclusively herbivorous and it feeds primarily on land. Further research might reveal a formula or rule of thumb for farmers about how many acres does it take to raise a goose.

In this study, casual observation of nest sites suggested that they were chosen for the view, "giving the incubating female a clear line of sight to detect approaching predators" (Hanson, Bailey and Hughes, 2003). We found a two nests in thickets, and one was in a forest, on top of an old river bank. Although the exact locations of goose nests usually changed from year to year, the same general areas were often used again. "Female Canada Geese always return to nest in the same area where their parents nested and often use the same nest site year after year" (Hanson, Bailey and Hughes, 2003).

On the Englishman River estuary during 2008, it appeared that the majority of eggs were laid in April and by 20 April, most of the eggs were being incubated. Most of the active nests observed in this study seemed to have four to eight eggs. The literature reports that the female sits while the male often stands guard, but sometimes it seemed that the males (presumably) vacated the nest area and the female stretched her head down to avoid detection. Hatching occurs after 25 to 28 days of incubation (Hanson, Bailey and Hughes, 2003), which seems to be mostly in May on the Englishman River estuary. Sometimes when a nest was predated or destroyed, it seemed that a second, smaller clutch was produced in a smaller nest.

Coinciding with the increasing resident goose population, we can see transformations occurring on the estuaries in the Parksville - Qualicum Beach area. In particular, Lyngbye's Sedge often appears mowed or it is has disappeared completely from some areas that have easy and safe access for geese. The channel edge plant community, where Lyngbye's Sedge often grows in a nearly monospecific stand approximately one metre tall, appears to be one of the first targets of grazing geese. In some plant communities that were once dominated by sedge, the tops have been eaten down to the ground and the roots grubbed out. In other parts, the roots seems to have died after their tops were overgrazed. Either way, the result seemed to be a disintegration of the marsh platform as the unattached fine sediments start to wash into the low marsh and, in some cases the whole marsh platform develops pits, gullies and mounds, or it breaks off and slumps down in chunks.

For descriptive analysis, the effects of intensive grazing can be seen as distinct stages.

A reduction in the height of plants
In some spots where geese could not get to easily, for example behind a narrow log, we observed the same plant community as was present a few centimeters away, but the height of the inaccessible plants was higher and the leaves did not have squared ends. Often, where accessibility of the forage plants decreased, the heights of the plants gradually decreased, creating tapered or windswept effect.

A shift in plant species composition
The geese seem to selectively remove Lyngbye's Sedge and, to a lesser degree, Sea Arrowgrass, Seashore Saltgrass, Sea Plantain and American Saltwort. The plant community appears to shift towards a much lower total biomass and a higher proportion of plants that the geese do not seem to like, such as Sea Milkwort and Silverweed.

A boundary separating vegetated from unvegetated ground
The grazing seems to be most intense in areas where the geese have easy access to and from the water, a clear view of potential threats, and few regular disturbances that they consider to be unsafe. In many of these areas, we find a boundary separating, on the one side, severe grazing down to eroding mud, and on the other side, a plant community where grazing may be present and the species composition may have been altered, but the marsh platform of roots and sediment is still intact and alive. This line is referred to in this report as the active grazing front.

Pits, hummocks and gullies
In some areas, the edge of the grazing may not be a sharp line but rather an area of pits, hummocks and gullies just above the receding line of vegetation, as if the geese return to grub and burrow with their heads below ground at individual spots where they have broken through the tough surface sod into the edible root layer of the marsh platform. This seems more likely to occur in areas that meet the needs of the geese for easy access and safety.

Collapsing marsh platform or collapsed segments nearby
The receding edge of vegetation is, in some spots, also the location of a sharp drop in elevation that varied in height but which was, in some places, more than a vertical metre. At the edge, what remains of the marsh platform is an overhanging mat that may have been undermined by grazing from below and/or by erosion as the receding roots release the organics and fines of the substrate into the water. Near the San Pareil Lagoon and at the north end of the Big Island, there were chunks of marsh platform that sometimes formed islands of lush high or mid-marsh vegetation towering above the flats on a steep bank of silt. They seemed to be intact and connected at the base to their original location, but completely isolated by a sharp line of vegetation.

Remnant sediments
In some areas after the marsh platform of roots and sediment has disintegrated, and slumping has occurred, the finer sediments like silt and organic mud get eroded away leaving pebbles or compacted silt/clay. This appears to be habitat suitable for Sea Milkwort and two non-native species, European Common Saltwort and Brass Buttons.

Mud-filled channel
The final stage in some areas, especially where the marsh platform has collapsed into a tidal channel, is a trough of unvegetated or sparsely vegetated mud that fills in those parts of the channel that would formerly have provided shaded and hidden pools for invertebrates and fish during low tide. Some of these areas seem to be suitable the native species Low Clubrush and Canadian Sand-spurry (*Spergularia canadensis*) as well as the invasive low marsh plant, Brass Buttons.

The Canada Goose Issue - What Are the Options

At the centre of the issue, the options with regard to the Canada Goose appear to be few. If the non-native subspecies and crosses that do not migrate continue to grow in population, then the habitats they depend on, including the Englishman River estuary, will simplify until they are not suitable to meet the needs of these geese. Science provides us with tools to hypothesize about natural laws and test these hypotheses; unending growth of any population within a finite world would contradict several of the laws of physics (i.e. thermodynamics) which have never been found false. Whether we as humans take responsibility for our earlier actions which modified local Canada Goose behaviour and genetics, or let natural processes solve the imbalance in its own unpredictable way -- that is the only real question at hand. In any case, the population cannot keep growing forever.

The local carrying capacity for the Canada Goose is not known, but based on the area of the plant communities that have disappeared or changed into an early seral form, it appears that the geese have already exceeded the practical size limit of a stable population in balance with its habitat.

The management plan could propose to:

1. do nothing, and let habitat destruction from grazing and natural population control take its course.
2. delay the issue and hope that casual egg addling and fencing will become more effective over time.
3. increase human hunting of geese by making it easy for bow hunters and others. It would useful to monitor this to see if hunting actually limits the population.
4. increase access by predators by buying or securing sufficient wildlife corridors to allow easy access to the estuary by big predators such as bears, wolves and cougars. Regular use by Minks and Otters was observed on the spit area at the mouth of the Little Qualicum River, but that did not prevent the geese from producing a high density of goose nests in the same area in 2009. It would appear that these smaller predators might not be interested in goose eggs or adults as prey at nesting time, possibly because the geese are too powerful. Therefore a larger predator would be needed
5. lower the goose population by some kind of cull.

So the choice is not whether the goose population will be controlled, the choice is how. If natural processes are allowed to prevail, the observed conversion of the lush sedge marshes to Sea Milkwort and bare substrate will likely continue. Some species will disappear from any location where geese feel safe. The banks of the tidal channels will continue to slump making unusable for fish during low tide. In order to have an estuary with the highly productive sedge plant communities intact, it would appear that it is necessary to take steps to control the geese, even though control of Canada Goose was not historically necessary, before the introduction of the mixed birds that do not appear to migrate.

Ring-necked Pheasant or Common Pheasant (*Phasianus colchicus*)

The Ring-necked Pheasant is present in low numbers on the Englishman estuary. In this study, their vocalizations were frequently heard from the shrub and high marsh areas around the Western Marsh. The population appears to be low and stable so no control measures are recommended.

California Quail (*Callipepla californica*)

This exotic species is well established on the estuary, although it was not seen during this study. There is no evidence that its population is increasing so no control measures are recommended at this time.

Barred Owl (*Strix varia*)
The Barred Owl was observed by the Arrowsmith Naturalists (2009) in June and July 2007, and in this study, it was heard during the day in June 2007. The Barred Owl is not native to Vancouver Island, however sightings of this species on the Englishman estuary go back at least as far as 26 October, 1993 (Dawe et al., 1994 cites Keith Fortune).

Its presence on the estuary is of some concern, partly due to the possibility that it might be feeding on the smaller owls, and in particular, the Vancouver Island subspecies of the Western Screech Owl (*Megascops kennicottii kennicottii* BLUE-listed, BCCDC 2009 and the Northern Pygmy Owl (*Glaucidium gnoma swarthi* BLUE-listed, BCCDC 2009). Anecdotal evidence by the authors of this study suggests that the Western Screech Owl on Vancouver Island might be in decline in some areas such as west Qualicum Beach where the distinctive "bouncing ball" rhythm of the owl's call used to be heard regularly in 1986 and 1987. Habitat changes from natural succession could also account for this hypothetical decline of Western Screech Owl on Vancouver Island. Control of the Barred Owl on the estuary is not recommended at this time, however no effort should be made, for example through nest boxes, to encourage it.

European Starling (*Sturnus vulgaris*)
In downtown Courtenay in the autumn of 2000, the authors observed starlings in flight occupying one quarter of the sky; a crude estimate of their numbers at that time put the total at approximately 30,000 starlings in view at one time. In this study, flocks of several hundreds of European Starlings were seen using the Western Marsh of the estuary in 2008. This is similar to the peak number of 363 starlings reported by Dawe et al. (1994). That report also noted the species numbers were highest on the western part of the estuary and in the trees just beyond the western boundary of the study area.

It appears that the numbers of the European Starling have stabilized on the estuary. No control is recommended at this time, but every effort should be made to ensure that the needs are met of raptors that feed on starlings, such as the Merlin, Coopers Hawk and Sharp-shinned Hawk. As new information becomes available, or if the population of Starlings increases, it might be necessary to use control measures. In Spain, nets are used to capture starlings as a seasonal delicacy for human consumption in some large cities.

House Finch (*Carpodacus mexicanus*)
Although the House Finch it is native to Mexico, it appears to be completely naturalized since it arrived on Vancouver Island in 1937 and started over wintering around 1951 (Campbell et al., 2001, cites Cowan, 1937, and Clay, 1952). The House Finch has been present on the Englishman River estuary since at least as far back as 1979 (Dawe et al.,1994) when a peak of 34 birds was seen in December. The Arrowsmith Naturalists (2009) recorded a peak of 71 birds in October, 2008. Thus, it appears that the population of the House Finch on the Englishman River estuary has been long established and is likely stable, so no control measures are recommended at this time.

Eastern Cottontail (*Sylvilagus floridanus*)
This exotic species of rabbit was introduced to Vancouver Island by an intentional release near Sooke in 1964 (Nagorsen, 1990 cited in RISC, 2009) and its range has been expanding northwards ever since. There may have been earlier releases as well. The species was present in the Parksville / Errington area in 1986 but it did not appear to have reached Qualicum Beach at that time. Today it is present on the east side of the island from Victoria to Campbell River and Sayward. In spite of the recent expansion following its arrival, its population appears to have been stable on the Englishman River estuary over the last 10 years of casual observations. No control measures are recommended at this time.

Domestic Cat (*Felis catus*)
Three domestic cats were seen roaming the estuary during the study period. The local impact of this species on the estuary is not known. Birds may not have any defence against small feline predators because none were present on Vancouver Island until the arrival of people of European decent. As part of a comprehensive public outreach campaign, the problems with roaming cats could be discussed, and cat owners encouraged to keep their pet inside or, at the very least, bell the cat.

Domestic Dog (*Canis lupus familiaris*)
We recommend that dogs be kept on a leash throughout the estuary. If there are many complaints about this, a local dog club has the option of organizing an "Off the Leash but Under Control" training course for dogs and their owners. The Greater Vancouver Regional District operated a similar system at Campbell Valley Regional Park.

Human (*Homo sapiens*)
The human species is native to this area; middens and burial grounds suggest that human presence may have been continuous for thousands of years. However, the humans that occupied the Englishman River estuary did not have motorized quads and chainsaws. Today these and other tools, although not welcome on the estuary properties, find their way in. The tracks a quad made on middle and high marsh areas within the estuary were still visible in a ground photograph taken from a distance 7 months later. The chainsaw cuts on some Broad-leaf Maple joints, likely to obtain burl-grained or bird's-eye wood, are still visible 10 years later. Last year's ground cleared clean of Nootka Rose on Big Island to grow marijuana (*Cannabis spp.*) and the campground full of garbage that growers used is still present not far from this year's new clearing. A wildlife manager's biggest task is not managing the wildlife; it is managing the people (Neil Dawe, 1997, pers. comm.). Controls on this species' activities on the estuary is recommended.

For Nature Trust and others, it must be a continuous burden to maintain fences and keep in contact with the problems occurring at the local scene. It is the hoped that this report will contribute to public knowledge and awareness and, in this way, make the task of management a little easier.

5.3.8 Some Non-native Species To Prepare For

A large number of invasive species are present on the east side of Vancouver Island. Here are a few examples of species that were not observed on or adjacent to the Englishman River estuary study area, but are known to occur within the region and would likely find suitable conditions for rapid expansion there, if given a chance to become established. It is recommended that people concerned about the estuary become knowledgeable and prepared for the controversy that might arise if these and other animals come into conflict with the delicate native fauna and flora of Vancouver Island.

Chervil or Wild Chervil (*Anthriscus sylvestris*)

Is present on the estuaries of the Little Qualicum River estuary and Nanoose/Bonell Creek estuary.

Giant Hogweed (*Heracleum mantegazzianum*)

Is abundant on French Creek.

The Great Grey or Leopard Slug (*Limax maximus*)

Occurs in Qualicum Beach.

The Eastern Grey Squirrel (*Sciurus carolinensis*)

Is a highly invasive species that usually appears in its fully black phenotype on Vancouver Island. One was observed during the study period near French Creek in 2007 and one black squirrel was seen near the E&N railway station in Qualicum Beach in 2008.

The final list of all invasive species that has been identified on the ERE in this project will be forwarded to the BCCDC. This will add to their data about species, occurrences and ranges.

Plant Photo Page 1

Plant Photo Page 2

Plant Photo Page 3