Canadian Forestry Service, Retired

Whitefish, Montana, April 2002

My Beginning:

My talk is comprised of three parts. 1) will begin with a few words about my upbringing, and major events in my early life, 2) next, I will relate some of the events that shaped my career, and 3) conclude with a few comments about mountain pine beetle biology and management.

(1) My parents had a small farm in the middle of the plains region of central Hungary. By the time I was old enough to go to school, I was expected to pitch in to help tending the livestock and the crops. From grade1 to grade 8 I went to a 1-room country school with 25-30 students counting all grades. I was the only student in grades 6 to 8. In my senior years I was expected to supervise the younger students and check their homework. One end of the school building housed the living quarters of the schoolteacher, Mrs. Sebestyen. School started at 8AM but the students were expected to be seated at their desks by 7:40AM and sing out the multiplication table from I x 1 to 12 x 12 and loud enough to be heard from the teachers living quarters. Doing this day after day, year after year was mind numbing but on the positive side none of us graduating from that school had troubles with multiplying small numbers.

Mrs. Sebestyen was an excellent teacher, kind, knowledgeable, and inspired interest and enthusiasm about learning. To this day she remains my idol. I am convinced that without her guidance and enthusiasm I would have dropped out of school and become a farmer. She was instrumental in making up my mind to further my education. Among the many things I have learned from her was that "ignoring the facts does not change the

facts". This advice came in handy throughout my research career. After finishing grade school, I wanted to enroll in teachers college to become an elementary school teacher. However, since I have no ear for music and being able to carry a tune was one of the prerequisites, I failed my entrance exam. Hence, I fell back on my second choice of a high school education.

In high school I especially liked the natural sciences and set my heart on studying astronomy after graduation. However, in the communist system of higher education the number of graduates in a field was limited by closing the first year of the faculty in that field for various lengths of time to control the number of practicing professionals. It just so happened that when I graduated from high school they closed the first year of the only faculty of astronomy in the country. So how did I end up studying forestry? After completion of the high school exams, I was playing ping-pong with my best friend. During the game I asked him which field is he trying to enroll at university. He said forestry. So, by the time the game ended I warmed up to the idea that I too would like to be a forester. A corollary to this story is that my friend failed the entrance exam and I succeeded. To this day, I feel some guilt about the possible role my success may have played in denying his aspirations.

Sopron and the Uprising:

In October 1956, 6 weeks after starting my classes in the Forestry Faculty at the university in Sopron, the Hungarian uprising broke out against the Communist regime and the Russian occupation. The university participated in the armed resistance. As a consequence, when the uprising was put down, a large part of the students and academic staff moved to Austria, I was among them.

Stay in Austria:

Austria, being a neutral country, was compelled to intern us, fearing that if they did otherwise the Russians would use it as an excuse to re-occupy their country. The Austrians treated us very well. We were put up in a vacated 2nd World War American Army base and spent the next two months playing soccer and trying to learn some German. In the evenings small groups of us were allowed to go with the guards to the local beer halls. Even though we were not solders, the Austrians felt it necessary to designate us such since some of us had small arms when we crossed the border. Not only that, since we were university students they felt compelled to give us ranks. So I became a sergeant and drew a salary of 80 Schillings per month. One funny episode stands out in my mind from my stay at the camp. After about a month of repeated assurances by the authorities that we will be allowed to leave the camp shortly, we grew weary of the delays and started a hunger strike. Naturally, the Austrians were quite troubled by this, especially when on the third day into the strike one of my classmates became seriously ill. He was taken to the hospital for tests where it was discovered that

he was suffering from chocolate poisoning! Since we were paid and the only thing we could spend it on was soft drinks and chocolates from the vending machines in camp, in preparation for the strike most students stashed away a supply of chocolates in anticipation of a long hunger strike.

Fortunately, shortly after this episode we were allowed to leave the internment camp and received the exciting news that the Canadian Government has invited us, 150 students and about 30 faculty, to come to Canada, join the Forestry Faculty at UBC, and to continue our education, in Hungarian, using our own professors. So, at the end of December 1956 we set out on our journey, traveling from Austria by train through to Belgium and then to England. We sailed on New Year's Day, 1957, from Liverpool and arrived to St. John, New Brunswick, one week later.

In Canada:

We traveled by train to Vancouver, and on to Powell River where we spent 4 months learning English. In the fall, 1957, the first year of instructions begun at the Sopron Faculty at UBC. The Sopron Faculty was a sister faculty of the Forestry Faculty of UBC, the difference being that in the Sopron Faculty initially the language of instruction was mostly Hungarian and changed to mostly English as the students gained facility in that language. The curriculum was based on the curriculum of the parent Alma Mater in Hungary. The diploma from the Sopron Faculty was recognized both in Canada and the USA. The Sopron Faculty ceased existence in 1961 following graduation of the last class of which I and Imre Otvos were members. The graduates of this faculty spread across Canada and the USA but most remained in BC. A large proportion of the students obtained graduate degrees and held important positions in academia, government and industry. In forestry circles in BC the group is affectionately known as the "Hungarian Mafia!"

Graduate Studies:

I entered graduate school at UBC during a period when the main means of combating insect problems was through the use of pesticides. When I solicited the advice of a practicing forester what he thought about a career in forest entomology his remarks were not very encouraging. He thought that the practice of entomology in the near future will pretty much gets reduced to the following two basic activities: 1) applying the insecticide, and 2) counting the dead. On the research side, however, it was an exciting period for forest entomology. The Green River project in New Brunswick on the Spruce budworm was in full swing. This was the first major project on the dynamics of a forest insect in North America. There were several other on-going, in-depth population studies on other forest insects including the larch sawfly, the lodgepole needle miner, and at least three destructive species of bark beetles. Other projects included host resistance

to bark beetles and some of the pioneering investigations on chemical communication in forest insects.

My interest in insect population studies was kindled by the publications from the Green River Project, especially the work of Dr Frank Morris. I had met Frank Morris only once, shortly after I joined the Canadian Forest Service. Over lunch, he related the following story that had a deep impression on me. Shortly after the Green River Project was organized it was decided to invite Sam Graham, the famous forest entomology prof from the University of Michigan, for a week to review and critique all aspects of the project: the objectives, the field and lab work, and data analysis. Sam was to accompany the research team to the field to witness the methods of sampling, data acquisition, and handling of the various lab-rearing programs. On the last day he was to give a critique of the work. When the time came for Sam to make his comments, he said the following: 'All aspects of the work are well thought out and the various measurements are made with great care. The only criticism I have is that everything is being measured and nothing is being observed.' Obviously, these remarks left a deep impression on Frank because his subsequent work on the fall webworm was a classic in integrating field observations and measurements in interpreting the ecology of this species.

Starting My Research Career:

(2) Half way through my PhD work in the mid-1960s, Roy Shepherd hired me to do research on mountain pine beetle populations at the Calgary Lab of the Canadian Department of Forestry. At the time Roy was section head of forest entomology research. He was a brave man to take a chance on a fellow who at the time only had textbook knowledge of bark beetles. Incidentally, I filled the vacancy created by the retirement of George Hopping, one of the pioneers in bark beetle research in Western Canada and an authority on the bark beetle genus *Ips*. I joined a team comprised of Rob Reid, Malcolm Shrimpton and Stu Whitney. The three of them worked on various aspects of host tree-beetle-blue stain interactions, and my project involved description of the sampling characteristics of populations within and among trees, and the spatial distribution of attacks and brood within trees. This work was the subject of my PhD thesis. In the late 1960s, the team was joined by the late Jerry Lanier who continued Hopping's work in revising the genus *Ips*, and John McGhehey who worked on individual variation in egg production and egg viability, and differential survival of the sexes in the mountain pine beetle.

The diversity of interests and expertise within the group made for many stimulating discussions. The following particular incident comes to my mind. For several weeks at coffee breaks during a winter in the late 1960's, Malcolm, Stu and I discussed whether or not it would be useful to develop an experiment to test the resistance of lodgepole pines of different ages against the main blue stain fungi carried by mountain pine beetle. The main argument against doing the experiment was that we would just prove the obvious, that resistance is inversely related to tree age. However, the argument

persisted and it seemed that the easiest way out of the uncertainty was to do the experiment. So we did, and to our surprise, resistance increased with age up to the point near the maximum yearly wood volume growth and then declined sharply. This result was a clear demonstration that deductions based on so-called logical arguments can be misleading and there is no substitute for data based on well-designed experiment.

The first workshop I moderated at the Western Forest Insect Work Conference was on the subject of "What is wrong with forest entomology education today?" I invited 5 of the western forest entomology profs to participate. Naively, I thought that being professors I should have an easy time moderating the sessions. Boy, was I wrong! A few minutes after the session started, the invited participants started a vigorous debate on the merits of the current curricula and teaching methods, mostly ignoring my pathetic pleas for order. Near the end of the workshop, one of them directed the following remark at his fellow participant seated across the table from him. 'I will tell you what is wrong with forest entomology education! Old chicken pluckers like you and I should have been put out to pasture a long time ago'. Somehow I survived the event and through the years I have learned to appreciate the true value of the candid discussions that characterized most of the numerous workshops I have attended at this work conference.

The work on mountain pine beetle out of the Calgary lab of CFS culminated in two major publications: One was the synthesis of our understanding of the interaction between the beetle with its associated microorganisms and lodgepole pine. It described the nature and effects of these interactions on the onset, intensity and collapse of outbreaks and contained a map of outbreak hazard based on climatic factors. The second publication interpreted information on beetle population biology in terms of management. It emphasized that the long-term focus of management should be on lodgepole pine rather than the mountain pine beetle.

Malcolm Shrimpton, Stu Whitney and I were transferred to the Victoria Lab in 1972, principally to undertake studies of spruce beetle populations. So for the next 10 years my work involved population dynamics on that insect at two locations in central BC. This work has led to a conceptual model of spruce beetle dynamics, analysis of survival in stumps and windfall, measurement of absolute populations and associated mortality factors for seven generations. Currently, analysis of the data on factors affecting generation survival, and development of a hazard rating system occupy much of my time.

Later work on mountain pine beetle included studies of dispersal, rates of development at constant temperatures, effects of winter temperatures on survival, the bark beetle guild associated with lodgepole pine, and the effects of spacing and fertilization of mature lodgepole pine on mountain pine beetle attack. This body of work and other published information on mountain pine beetle biology was used in the development of a detailed population dynamics model for the mountain pine beetle. Also, in collaboration with Terry Shore, we developed a stand level hazard rating system for

mountain pine beetle and the spmce beetle. Currently, the rating system for mountain pine beetle and the population dynamics model are being used in an exciting new project to model infestation spread and intensification at the landscape level, and to assess the relative merits of various management strategies and tactics.

What Have We Learned About Bark Beetles and Management?

(3) In closing, I will say a few words about what I think we have learned about mountain pine beetle biology and management over the past 4 decades and refer to some misconceptions. Necessarily, what follow will be just brief statements on various aspects of biology and management without elaboration. For those of you who may want to discuss any or all of the following statements I am willing, especially over a glass of Guinness.

First, I will say a few words about mountain pine beetle generation mortality.

- Assuming an average sex ratio of two females per male, and an average of 60 eggs produced per female beetle, mountain pine beetle populations remain stable at 97.5% mortality.
- On a one-year life cycle and at about 95% generation mortality, population and damage levels will double each year.
- Thus, contrary to popular belief, during epidemics generation survival is only a few % higher than during the endemic state. This modest increase in generation survival, however, will remain steady for a number of generations.
- The challenge to research is to identify the factor or factors responsible for this small increase in generation survival during the beginning stages of outbreaks.
- As we can attribute only about 60-70% of generation mortality to known factors, there is a lot of room for improvement in our understanding of population dynamics.

The following statements relate to epidemiology.

- Secondary bark beetles are important factors of mortality in unmanaged, mature lodgepole stands, especially in the smaller DBH classes. At low endemic levels, mountain pine beetle often infests trees that are colonized by these secondary species. Therefore, it appears that stand hygiene is an important factor affecting mountain pine beetle survival at endemic levels.
- Mountain pine beetle outbreaks are loosely synchronized over much of the beetles range where the one-year cycle dominates, indicating that population change may be governed by the so called Moran effect.
- Although we can describe the changes in host conditions and weather factors that should occur as a precursor for a change from the endemic state to the beginning stages of epidemics, we still cannot predict the timing of such event.

- The main factors mostly responsible for the development of outbreaks are host susceptibility and suitability of the climate for beetle establishment and survival.
- Of the host factors, the presence of mature /over mature stands at the landscape level appears to be the most important.
- Of the climatic factors, unseasonably low temperatures, and temperature conditions during the growing season that affect mass attack and univoltine cycling of populations appear to be most important.
- Once outbreaks develop at the landscape level, the population's very size becomes a major factor in maintaining its momentum.
- In areas where mountain pine beetle outbreaks are most damaging, the beetle generally has a univoltine life cycle.
- Therefore, it does not necessarily follow that sustained increased temperatures such as those associated with climate warming would invariably result in greater average level of damage.
- The adverse effects of the very factors that are responsible for the development of the outbreak will eventually cause it to decline, namely reduction in susceptible hosts, increasing adverse climatic conditions, or a combination of these factors.

So what implications beetle population dynamics have for operational management?

- In the long term, the focus of management should be lodgepole pine and not the mountain pine beetle.
- Once scattered infested trees appear in some stands, it is usually a forerunner of the development of an outbreak in 5-10 years.
- The lack of knowing where the infested trees are, especially at low population levels, is rarely a major impediment to management: the lack of early and thorough management action on infestations is.
- There is generally a degree of pessimism, or at least uncertainty, even among forest entomologists as to our ability to control mountain pine beetle outbreaks and on the size of effort required for successful control.
- It can be shown that infestations can be suppressed but the work generally requires a large effort in terms of the proportion of trees that need to be treated annually. As a rule of thumb, the proportion of infested trees treated annually needs to be greater than (1- the average ratio of brood trees to currently infested trees). As an example, if the average ratio of brood trees to currently infested trees was 25%, one would need to treat more than 75% of the infested trees each year to be able to suppress the infestation.
- The commonly held argument that most epidemics are the results of populations building up in susceptible hosts within parks and other protected areas rest on the following assumptions. If such places did not exist outbreaks would not occur, or at least would occur less frequently, in forests managed for timber production. Based on current knowledge, it is unlikely that the frequency of outbreaks is materially affected by susceptible hosts in protected areas. However, the intensity and rates of spread of infestations are likely affected.

Looking Back:

I consider myself very fortunate to pursue a research career for 37 years in an important and highly challenging field. In my entire career I have worked mainly on two problems: the population ecology of the mountain pine beetle and the spruce beetle. When I started work on mountain pine beetle in the east Kootenays of BC in the mid-1960s, lodgepole pine was not considered an important commercial species. Consequently, there was not much sympathy on the part of small wood operators for research projects with a main objective of saving a tree species they had great difficulty selling. About a decade later, however, lodgepole pine became one of the major commercial species in the BC Interior. Commensurate with its commercial importance, interest grew steadily in industry and government in reducing losses from mountain pine beetle. With the increased environmental awareness during the past two decades, there has been steadily increasing interest by these agencies as well as the general public in the nature and effects of beetle-host interactions and the ecological role of damaging species such as the mountain pine beetle. As a consequence, information on beetle population ecology and management are in high demand by the forest industry.

Over my career I had the pleasure and privilege of knowing and working with a number of dedicated and highly talented foresters and forest entomologists. As well, my involvement with graduate students was a constant reminder that the profession is not short on talent. What we must ensure is a continuing opportunity for this talent to bear fruit in improving forest insect management.

As for me, I will continue to work on bark beetle projects as long as I am able. Why, you might ask. Simply because in the end all of us will conserve only what we love, we will love what we understand and understand what we are taught.

I thank the Award Committee who found me worthy of the recognition. It is indeed a great honor be the recipient of an Award that symbolizes the ideals of forest entomology practice.

I also want to thank my wife for her understanding and infinite patience that allowed me to work at home after hours, on weekends, and even on some holidays. My work certainly would have been lot more difficult without her support and that of my technician Doug Linton who keeps me on track and cheerfully performs even some tasks that are not only difficult but also of uncertain scientific value.

Thank you for your attention.

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