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A RATIONALE FOR WOLF CONTROL IN THE MANAGEMENT OF THE VANCOUVER ISLAND PREDATOR-UNGULATE SYSTEM

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SUMMARY

This report outlines the rationale for wolf control on Vancouver Island and details a program design to implement wolf control to manage wolves and deer intensively as part of the Island's predator-ungulate system.

Since the mid-1970's, deer populations in many areas on Vancouver Island have declined as a result of intensive wolf predation. Alternative causes, such as hunting, black bear and cougar predation, habitat and weather, can not account for the deer declines. Hunter harvests of deer have also declined and wolf densities in some management units (M.U.'s) have subsequently declined as well. Neither deer nor wolf management objectives are presently being met. The polarization of public attitudes to wolf control has been a major factor in delaying reactive management to this problem.

The proposed wolf control program is designed to enable recovery of important deer herds, and to ensure the long term maintenance of the Island's predator-ungulate system at viable densities. Key deer production zones, where habitat prescriptions have been implemented to provide old growth timber for winter range, will receive emphasis. Initial wolf reductions of 80% appear necessary to allow a suitable recovery period (5-10 years) for most deer herds on northern Vancouver Island. On southern Vancouver Island, wolf reductions are required to reverse indications of deer declines prior to reaching the low densities that have occurred on northern Vancouver Island. Incentives to increase wolf trapping activities will form the major control method at present. The program will enable wolves to slowly increase following initial intensive control. Following intensive control, random removal through hunting and trapping seasons will continue to determine whether it is sufficient to restrict increases in wolf numbers. To assist deer recovery, all areas with wolf control will be subject to decreased deer harvests by cancelling antlerless seasons and reducing the bag limit from 3 to 2 deer. Wolf and hunter harvest trends will be monitored in all areas where wolf densities will be reduced. Five representative areas will be used to provide a detailed evaluation of deer population responses to wolf reduction. The control program is expected to produce benefits with a gross value of almost $9 million (1985 dollars), at costs of about $250,000 for a net benefit of about $8.5 million (36:1 = Benefits to Costs).

INTRODUCTION

This report outlines the rationale for wolf control on Vancouver Island (Fig. 1) and details a program design to implement wolf control to manage the Island's predator-ungulate system. Scientific information regarding predator-ungulate relationships on the Island is summarized only. A more complete review of the information, including statistical analyses of the data, is available from the references.

THE PREDATOR-UNGULATE SYSTEM

A conceptual model of the predator-ungulate system on Vancouver Island is shown in Figure 2. The system is broken into two components, the interrelationships between predators, prey, and vegetation; and the influence of external factors on this system (i.e. weather, hunting, and forestry).

Within this system, deer and elk are managed principally as big game species with the primary use being hunting. Beaver are managed as furbearers, black bears and cougars as big game animals, and wolves as both big game animals and furbearers. Presently, the interactions between wolves, deer, and hunting are the dominant feature of this system.

THE PROBLEM

Since 1976, black-tailed deer populations in many areas on Vancouver Island declined as a result of intensive wolf predation (Hebert et al. 1982; Hatter 1983; Jones and Mason 1983). The most extensive declines occurred on northern Vancouver Island where wolf densities were highest, especially over the 1976-1979 period (Fig. 3a). Increasing wolf densities on southern Vancouver Island since 1981 have led to local deer declines as well (Fig. 3b). These declines, combined with reductions in the hunter harvest, have resulted in the Wildlife Branch not being able to meet deer management objectives. In addition, low deer populations could justify harvest of mature timber deer winter ranges resulting in habitat loss for many wildlife species. There is also increasing concern about the potential of wolves to reduce or remove specific elk herds during severe winters, and for the future population status of wolves as well. The long term expectation is for continued declines in deer, wolves, and the hunter harvest.

Although the preliminary wolf management plan for British Columbia has identified wolf control as a management objective when wolves are depressing ungulate populations (Ministry of Environment 1979), wolves have not been actively managed on Vancouver Island, apart from limited control in support of research. The polarization of public attitudes to wolf control has been a major factor in delaying reactive management to the problem. This has detrimentally affected attempts to integrate ungulate and predator management.

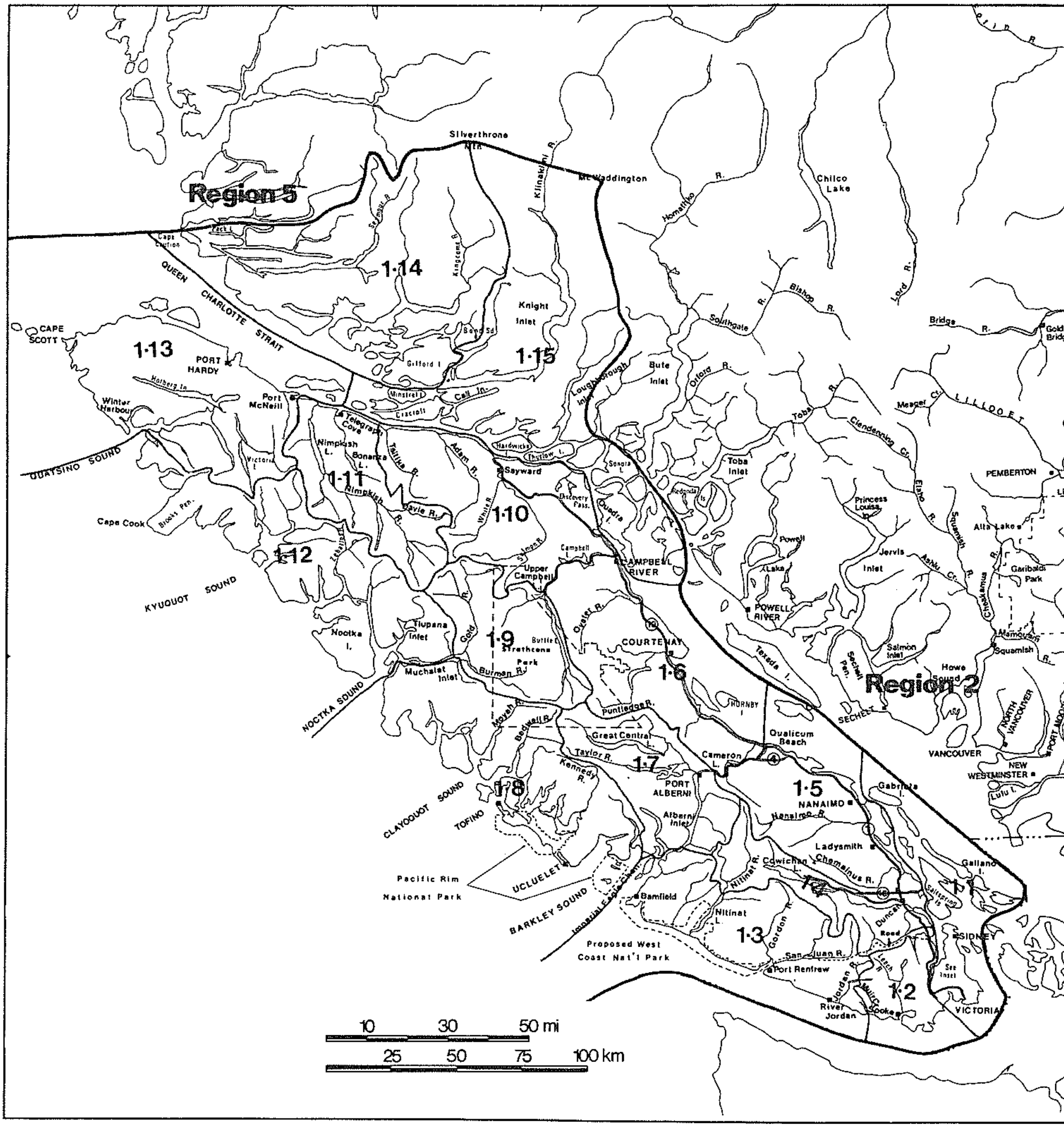

Figure 1. Wildlife management units (M.U.'s) on Vancouver Island. Southern Vancouver Island refers to M.U.'s 1 to 8 and northern Vancouver Island, from M.U.'s 9 to 13.

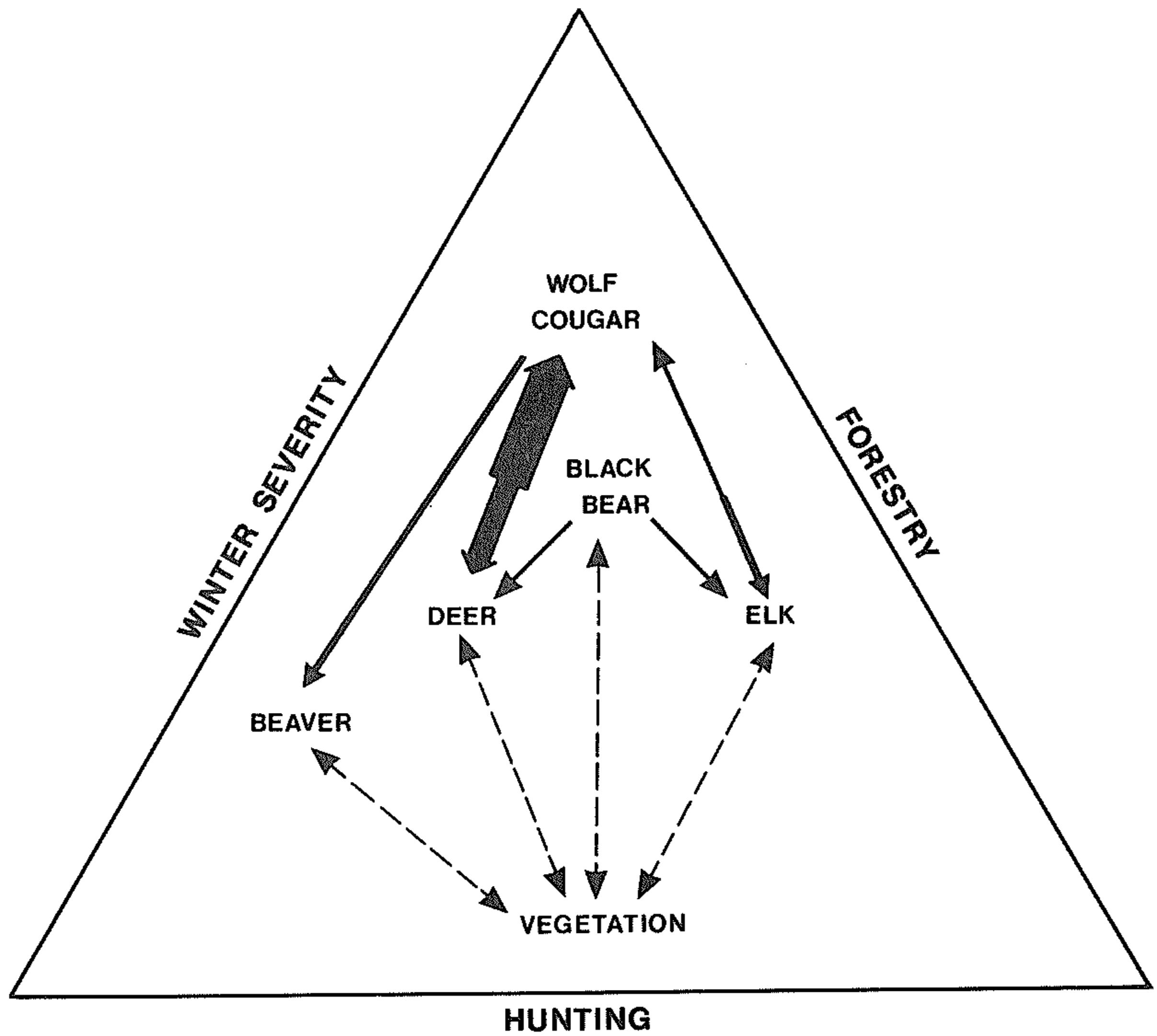

Figure 2. Conceptual model of the predator-ungulate system on Vancouver Island. One-way solid arrows indicate predator-herbivore interactions. Two-way solid arrows imply at least partial regulation between predators and herbivores. The thickness of the arrows indicates the importance of the interaction. Dashed arrows refer to vegetation-herbivore interactions (from Hatter 1982).

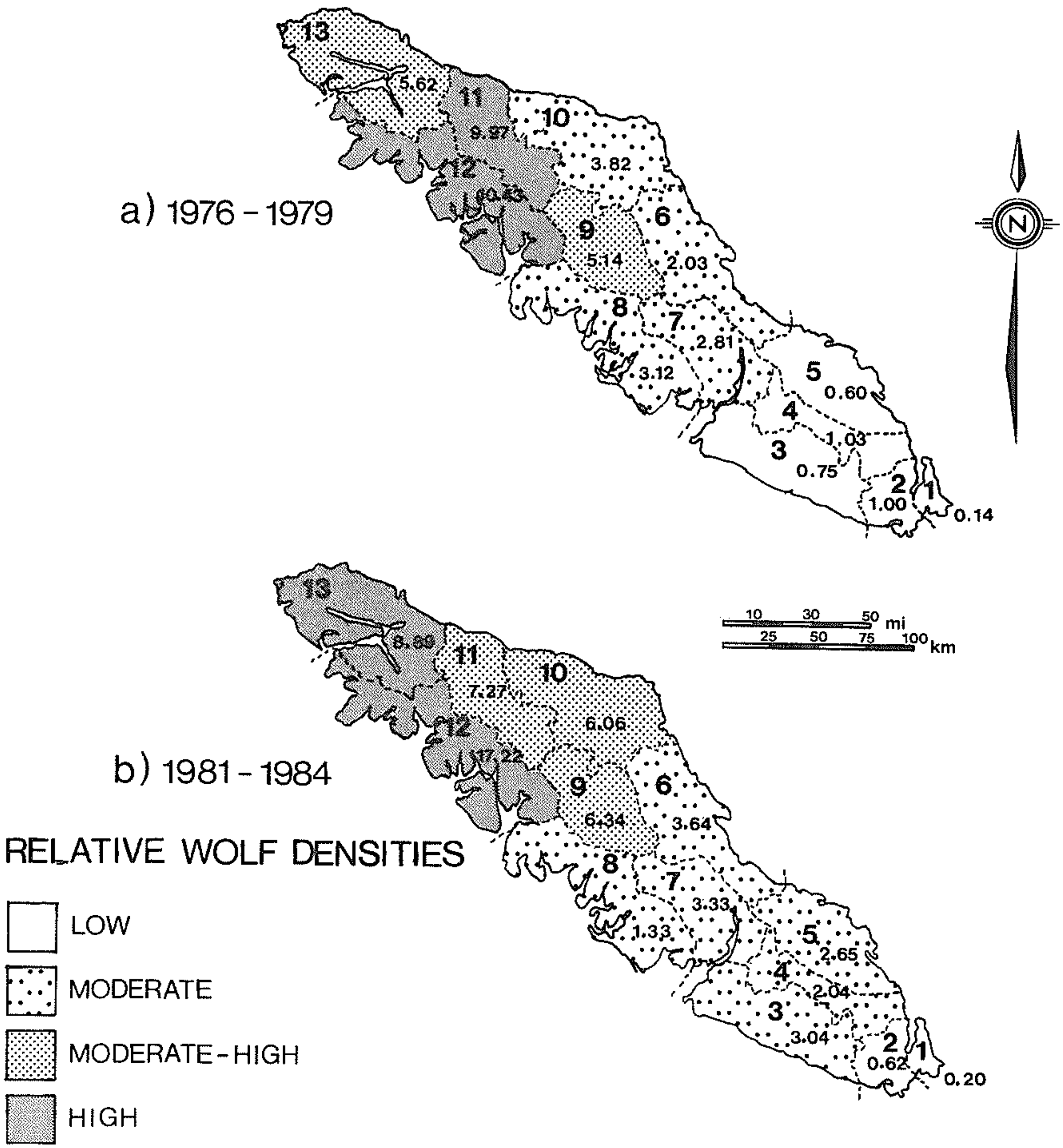

Figure 3. Relative wolf densities on Vancouver Island, 1976-79 and 1981-84. The wolf hunter sighting index (WHSI) is shown for each M.U. The index appears to reflect annual population changes in wolves and is calculated as the number of wolves observed per hunter day x 100 (Hebert et al. 1982).

RATIONALE FOR WOLF CONTROL

A simple logic flow-chart to determine the utility of predator control in predator-ungulate management is outlined in Figure 4. The subjective as well as the more factual aspects of this decision-making process are reviewed below.

What are the management objectives?

Four major management objectives for predator-ungulate systems are indicated in Figure 4. Deer and wolf management plans on Vancouver Island have the following objectives:

1. To maintain deer numbers at present day or historical levels, depending upon carrying capacity;

   a) in partially logged watersheds where mature timber has been deferred for winter range, the objective is to maintain deer production at levels comparable to the last 5-10 years (1970-80 average of 15-20 deer/km^2); and

   b) in second growth forests the objective is to increase production from the present level of 2-5 deer/km^2 to historic levels of 10-20 deer/km^2.

2. To maintain a minimum annual harvest of 15 000 $\pm$ 5000 deer (Fig. 5), generating 160 000 $\pm$ 20 000 hunter days of recreation.

3. To maintain wolf numbers at a level that does not threaten deer and elk populations and that will ensure the wolf's continued existence; and

4. To reduce wolf numbers in areas where wolves are causing a serious decline of a deer or elk population.

To meet deer objectives, two strategies or types of action are required: first, to optimize deer production in second growth and second, to maintain the habitat necessary to sustain deer in severe winters at numbers sufficient to meet production targets. To meet wolf objectives, the periodic use of wolf control is required to prevent major declines in their prey and subsequent declines in wolf numbers. Presently, deer and wolf management objectives are not being met as:

a) Deer populations in specific watersheds on northern Vancouver Island declined by 50 to 70% over the 1976-1982 period (Fig. 6a-c). Associated information suggests a major decline in deer numbers throughout most of the northern management units (M.U.'s) in both lightly hunted and heavily hunted watersheds (Hebert 1981). During the same period, the hunter harvest on northern Vancouver Island dropped substantially (Fig. 7a) with harvest declines ranging from 23 to 75% within individual management units (Fig. 8). Presently a harvest of only 9000 deer is being met Island-wide, with much of this attributed to increased harvests on southern Vancouver Island;

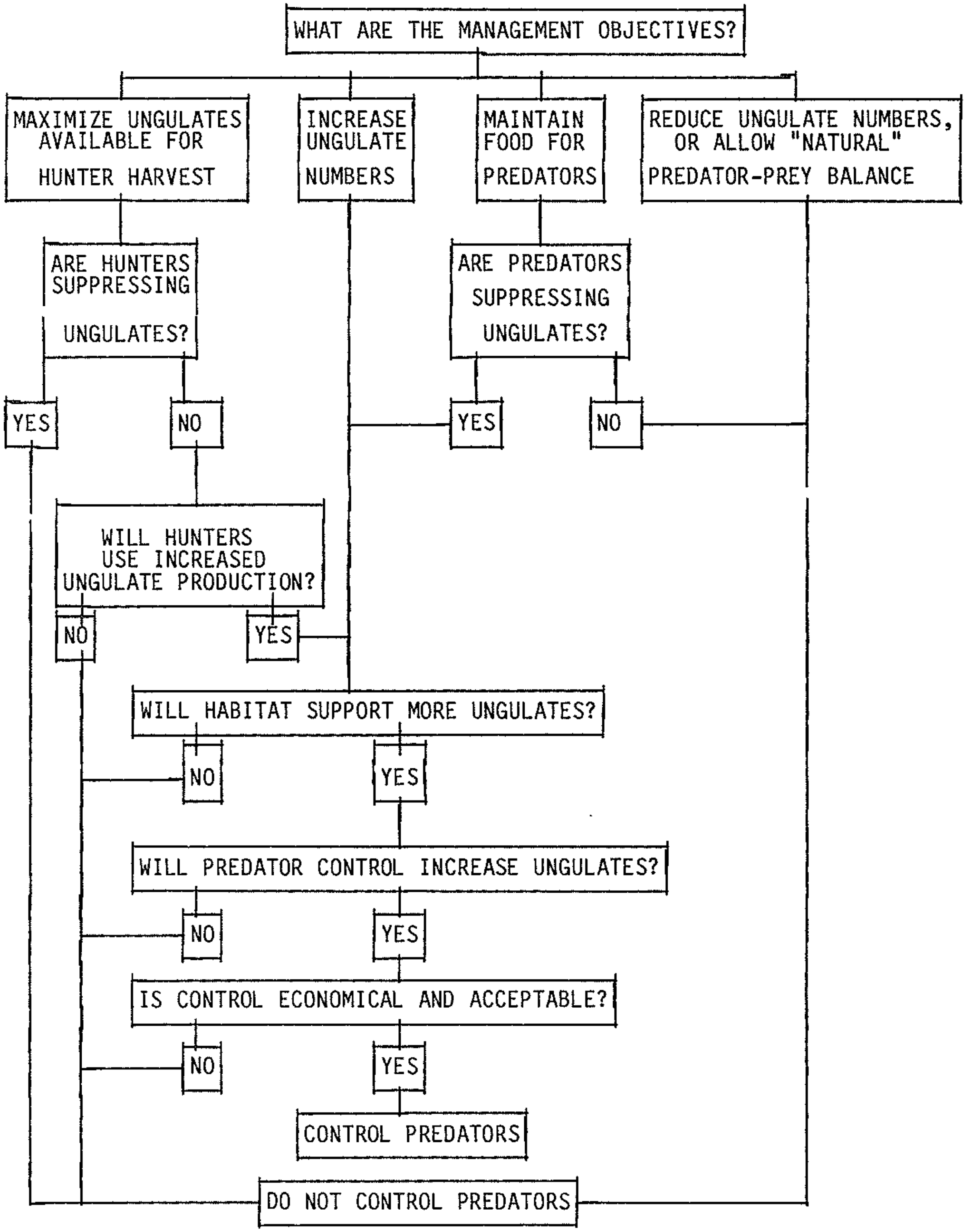

Figure 4. Rationale for determining the utility of predator control in predator-ungulate management (modified from Connolly 1978).

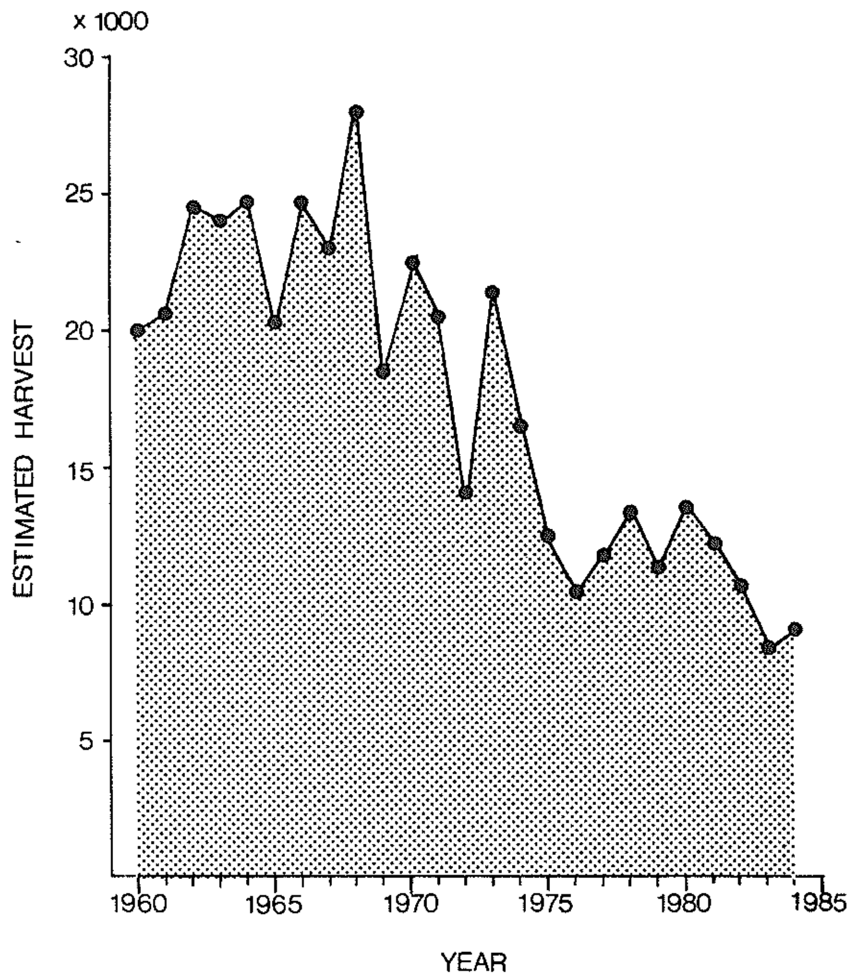

Figure 5. Estimated annual deer harvests on Vancouver Island, 1960-84 (from Hunter Sample).

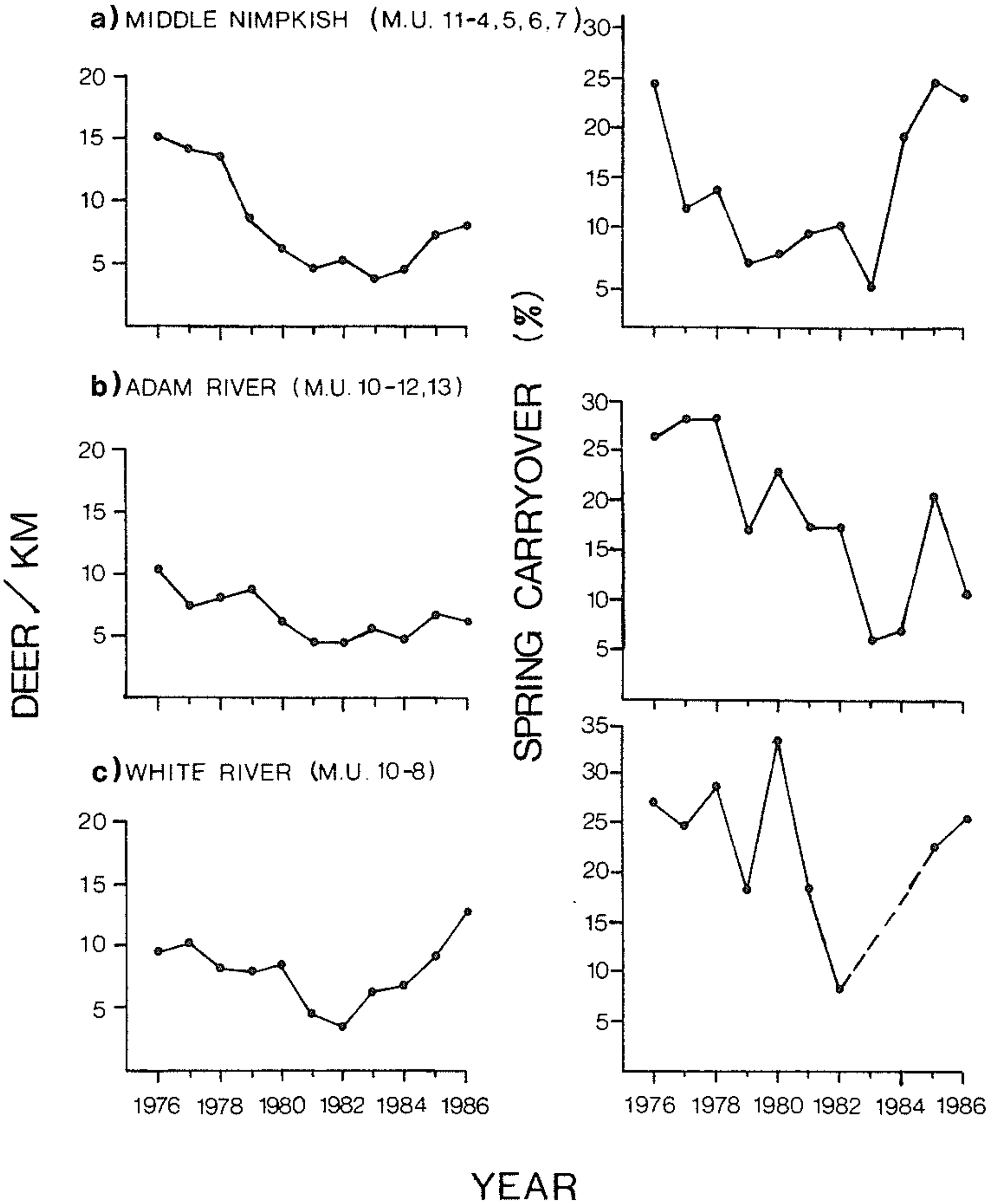

Figure 6. Deer population indices on northern Vancouver Island. Deer concentrated on spring ranges (open cutovers) in April and May are counted during the night (deer/km) and day (spring carryover). Night counts are conducted by shining hand-held spotlights from vehicles driven slowly along logging roads. The annual deer population index is calculated as deer counted per km of logging road transect. Day counts are conducted by walking logging roads and recording the number of fawns (10-11 months) and adults observed. Spring carryover is the proportion of fawns of all deer observed. Significant increases in the Nimpkish (a) and White River (c) population indices since 1982/83 have been the result of intensive wolf trapping activities.

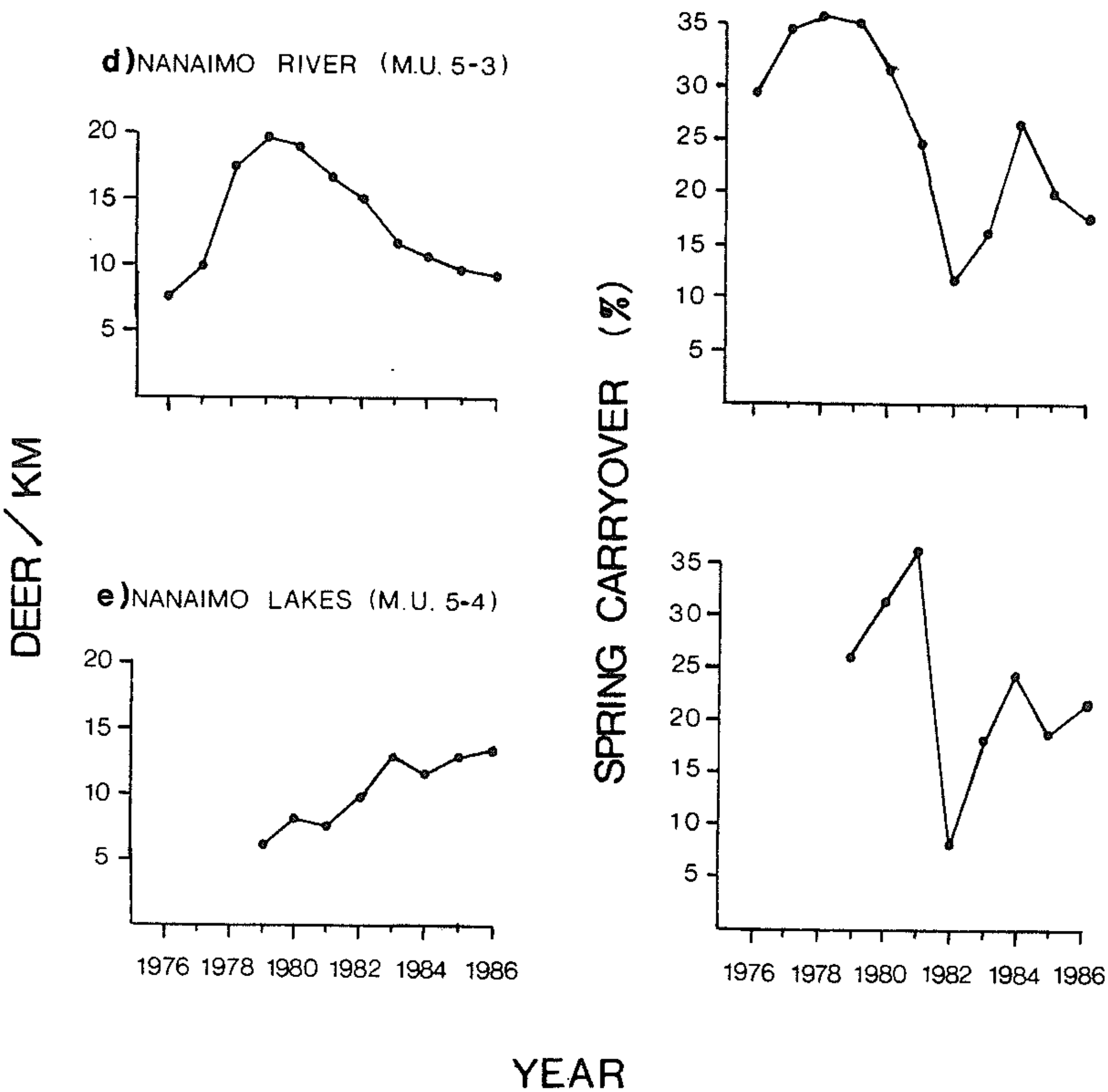

Figure 6. (cont'd) Deer population indices on southern Vancouver Island. Wolves have been periodically removed from Nanaimo River (d) since 1982.

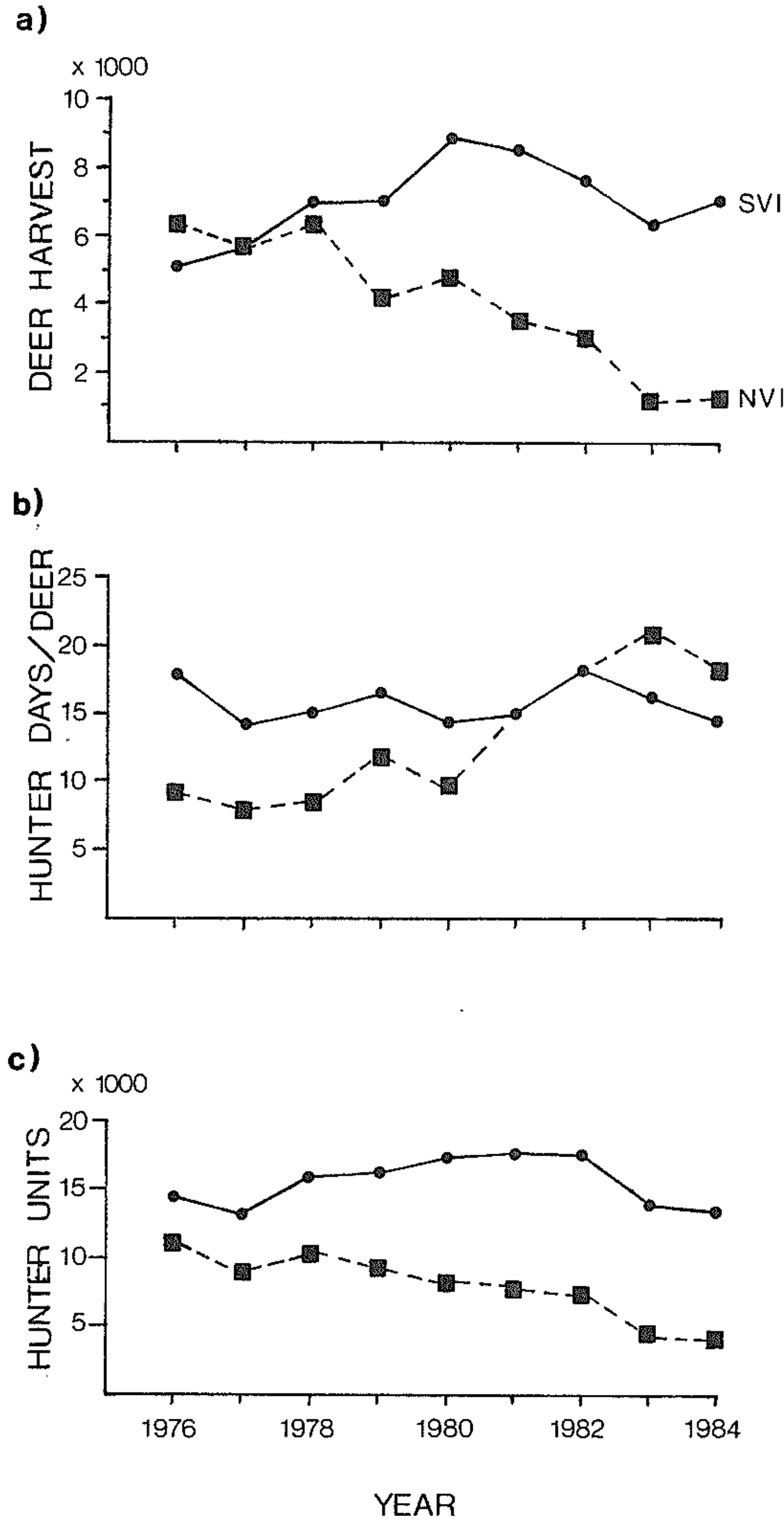

Figure 7. Hunter harvest statistics for northern (NVI) and southern (SVI) Vancouver Island: (a) estimated annual deer harvest; (b) hunter success (average no. of days required to shoot one deer); and (c) hunting activity (no. of hunters reported hunting in either region). The decline in deer harvest and hunter units on SVI since 1981 coincides with the increased occurrence of wolves in those M.U.'s.

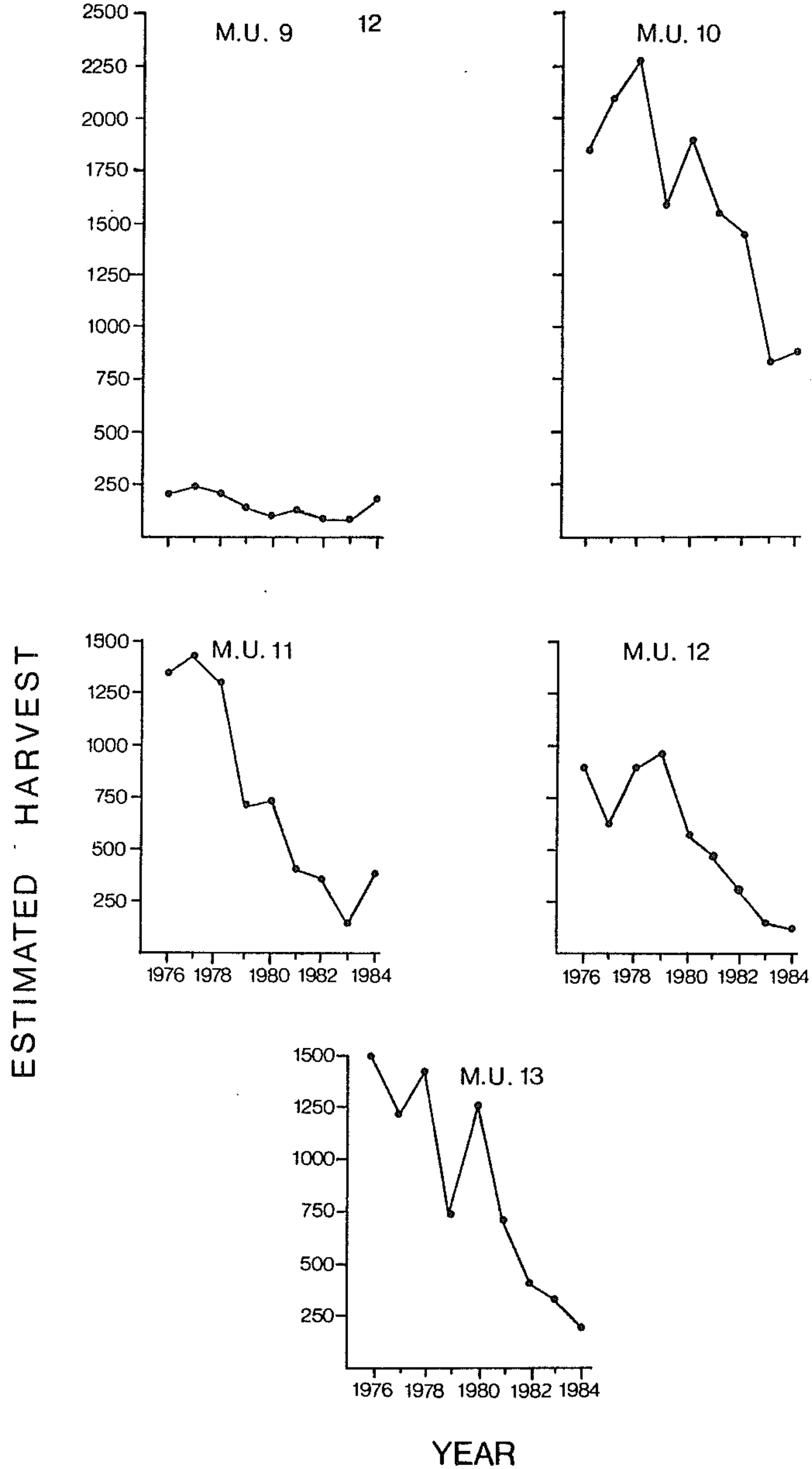

Figure 8. Estimated annual deer harvests for M.U.'s 9 to 13 on northern Vancouver Island.

b) In M.U. 11, deer population indices markedly declined during the period 1976-1982 under high wolf densities that also subsequently declined. In M.U. 10, where deer numbers appeared to be initially lower, deer population indices showed a less severe decline under a moderate, but increasing wolf density. In M.U. 5, where deer population indices were increasing during the period 1976-81, wolf densities were low, but have increased since 1981 (Fig. 3, 6, 9).

Although the objectives of maximizing deer for hunter harvest, increasing deer numbers, and maintaining food for wolves are applicable for predator-ungulate management on Vancouver Island, other objectives suggested in Figure 4 are not applicable, e.g. reducing deer numbers or allowing a "natural" predator-prey balance over the entire Island. In addition to meeting deer and wolf management objectives, the reality of the Island's wildlife-forestry situation dictates relatively high deer densities and harvests to justify retention of forested deer winter ranges in economically valuable timber. Presently, the incentive for land managers to defer mature timber for winter range is reduced because deer populations are far below the carrying capacity of the habitat, and harvests and associated recreational benefits are low.

Are hunters suppressing ungulates?

Although hunting pressure was substantial during the 1960's, and declined during the 1970's, the hunter harvest followed, rather than caused, the deer declines (Hatter 1983; Jones and Mason 1983). On southern Vancouver Island, deer populations increased (Fig. 6d,e) despite increases in the hunter harvest (Fig. 7a), whereas on northern Vancouver Island, the harvest declined as the deer population declined (Fig. 6a-c). Deer populations also declined in unlogged and unhunted watersheds where wolves were present at high densities (Fig. 10). Deer population trends are strongly associated with trends in fawn survival (Fig. 6). Hunting has not been the cause of low fawn survival as most of the fawn mortality occurs during the summer months, prior to the hunting season (Fig. 11). Anterless seasons on northern Vancouver Island were terminated in 1982 (M.U.'s 9, 11, 12 to 13) and 1983 (M.U. 10).

Will hunters use increased ungulate production?

Declines in the hunter harvest (Fig. 7a) and hunter success (Fig. 7b) on northern Vancouver Island, in conjunction with shifts in hunting activity to southern Vancouver Island (Fig. 7c) from 1976 to 1981 when deer densities were highest, indicates that hunters will use increased deer production.

Are predators suppressing ungulates?

1. Wolves

Numerous studies in North America have indicated that wolves can severely reduce ungulate populations (Parker 1972; Bergerud 1980, 1981, 1983; Gasaway et al. 1983; Peterson and Page 1983). Predator-prey investigations on Vancouver Island have indicated a rapid increase in wolf numbers, strong predation effects, and subsequent deer declines.

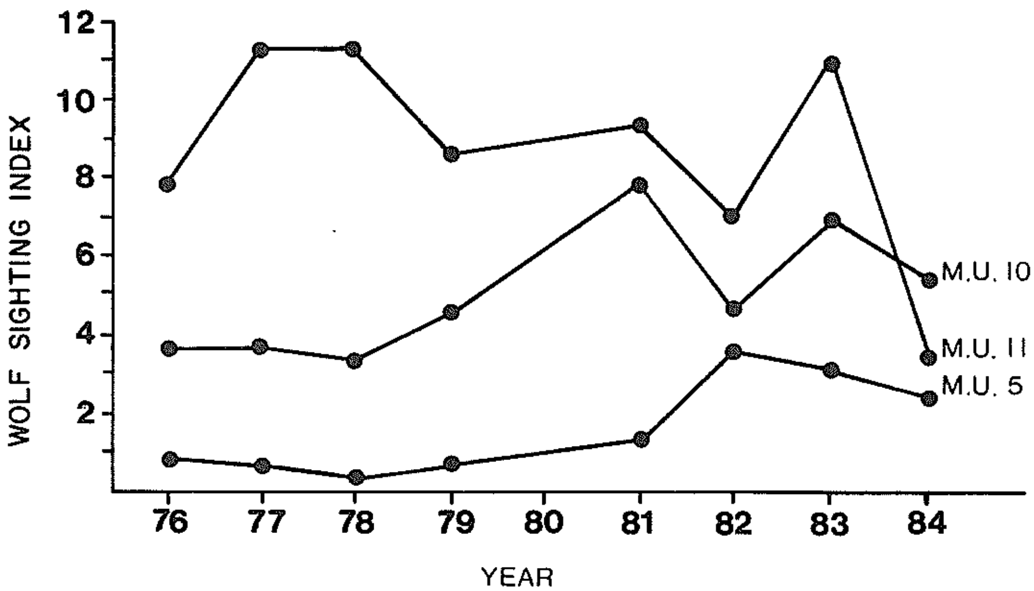

Figure 9. The wolf hunter sighting index (WHSI) for M.U.'s 5, 10, and 11. The increase in M.U. 11 in 1983, following a year of wolf trapping in the experimental wolf control study area, coincided with the increased occurrence of wolves at highly visible garbage disposal sites.

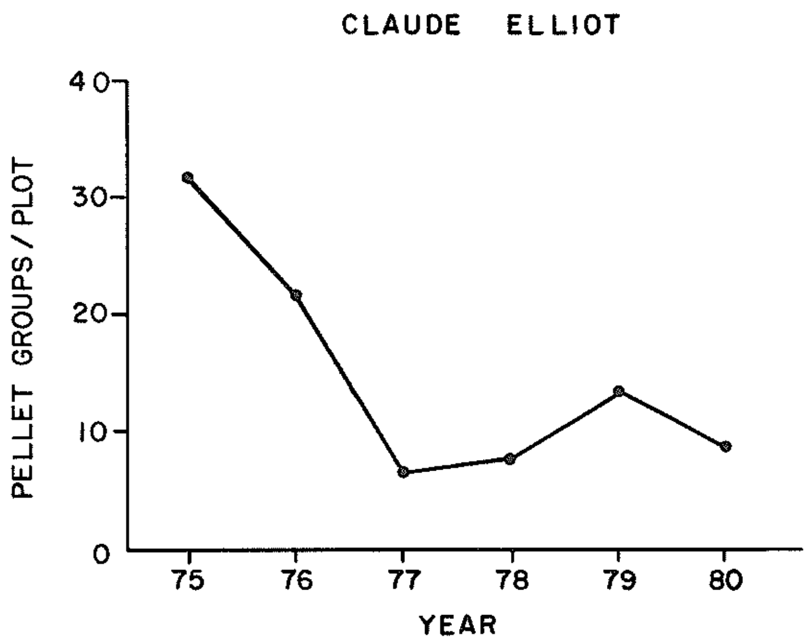

Figure 10. Deer population trend (Claude Elliot, M.U. 10-16) in an unlogged and unhunted watershed, based on pellet group counts (from Jones and Mason 1983).

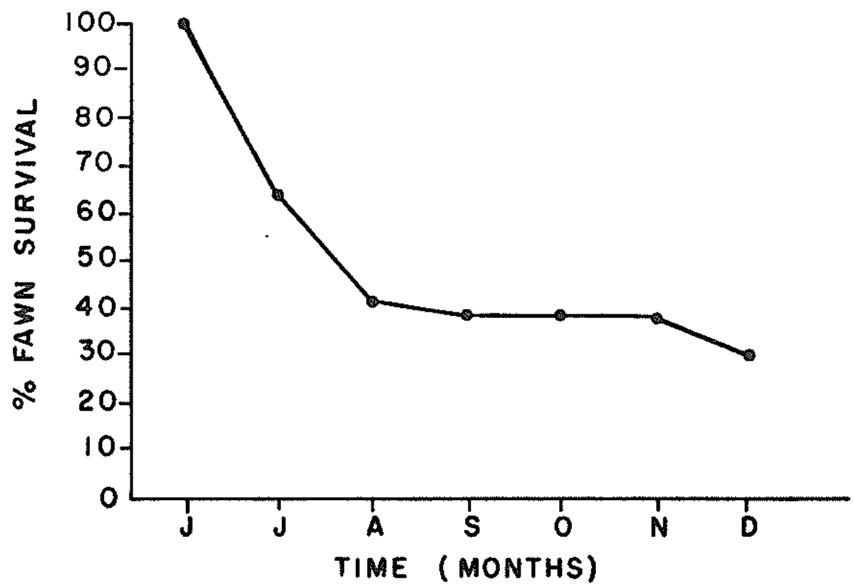

Figure 11. Cumulative percent survival of radio-collared fawns from June to December (1980-82) in the lower Adam River watershed (M.U. 10-13) (from Hatter 1983).

A substantial increase in the distribution of public wolf sightings occurred on Vancouver Island from 1972-76 (Hebert et al. 1982). In 1972, wolves were sighted in M.U.'s 5, 6, and 10 while by 1976 they were distributed throughout most of the 13 M.U.'s on Vancouver Island. A hunter wolf sighting index, initiated in 1976, suggested very high densities on northern Vancouver Island (Hebert et al. 1982). Summer wolf densities in portions of the Adam River drainage were estimated at 1 wolf/6-12 km^2 in 1978 with densities of 1 wolf/12-17 km^2 estimated for the entire Adam River watershed (Scott 1979; Hebert et al. 1982; Scott and Shackleton 1982). Densities were comparable in 1980, but slightly lower in 1981 (Hatter 1983).

Deer population trends from 1976-82 declined most severely in areas with the highest wolf densities and increased in areas where there were few wolves (Figs. 6 & 9). The greatest declines in deer/km occurred in M.U. 11 where the wolf hunter sighting index was greatest. In M.U. 10, where the wolf index was lower, declines in deer/km were less severe. In M.U. 5, where there were few wolves, deer/km increased. Other population survey information on southern Vancouver Island is limited, but trend counts in M.U. 3 (Caycuse) indicated a decline from 9 deer/km in 1981 to 3 deer/km in 1985, 5 deer/km in Sooke (M.U. 2) in 1986, and less than 1 deer/km was recorded in the Nitinat (M.U. 4) in 1984.

In the Nimpkish valley (M.U. 11), significant correlations were found between declines in summer fawn:doe ratios, spring carryover, and increases in wolf distribution (Fig. 12a, b) (Jones and Mason 1983). Population declines in different portions of the Nimpkish were also directly related to the appearance and increased activity of wolves (Fig. 12c, d).

In the Adam-Eve area, the deer/km index from 1978-79 declined by 33% and 9% in the Upper Adam and Lower Adam wolf pack territories, respectively, but increased by 25% in the vacant wolf area between the two wolf pack territories (Hebert et al. 1982). In 1980-81, wolf predation accounted for 8 of 12 radio-tagged fawn mortalities during the summer (Hatter 1983). Six out of seven fawns radio-tagged within two miles (3.2 km) of the Upper Adam den-site were killed by wolves. August fawn:doe ratios were also lowest near the Upper Adam den-site but increased with distance away from the den (Fig. 13). Wolf food habit studies in 1978, 1980, and 1981 indicated deer were the major food item for wolves (Scott 1979; Scott and Shackleton 1980; Hatter 1983). Fawns were an important component of the summer diet with approximately five fawns consumed for every adult deer (Hatter 1983).

2. Black Bears and Cougars

Bears can be effective predators on neonatal calves and fawns, especially for those species that predictably concentrate on discrete calving areas (e.g. moose, caribou, elk) (Schlegel 1976; Franzmann et al. 1980; Ballard et al. 1981; Ozoga and Verme 1982). Cougars can also be important predators on juveniles and are an important factor in dampening ungulate population oscillations (Robinette et al. 1959; Hornocker 1970). Bears or cougars may, in combination with hunting, limit some ungulate populations (Shaw 1977; Franzmann et al. 1980; Ballard et al. 1981). Evidence from Vancouver Island, however, indicate that black bear and cougar predation are not important mortality factors and did not initiate the deer declines.

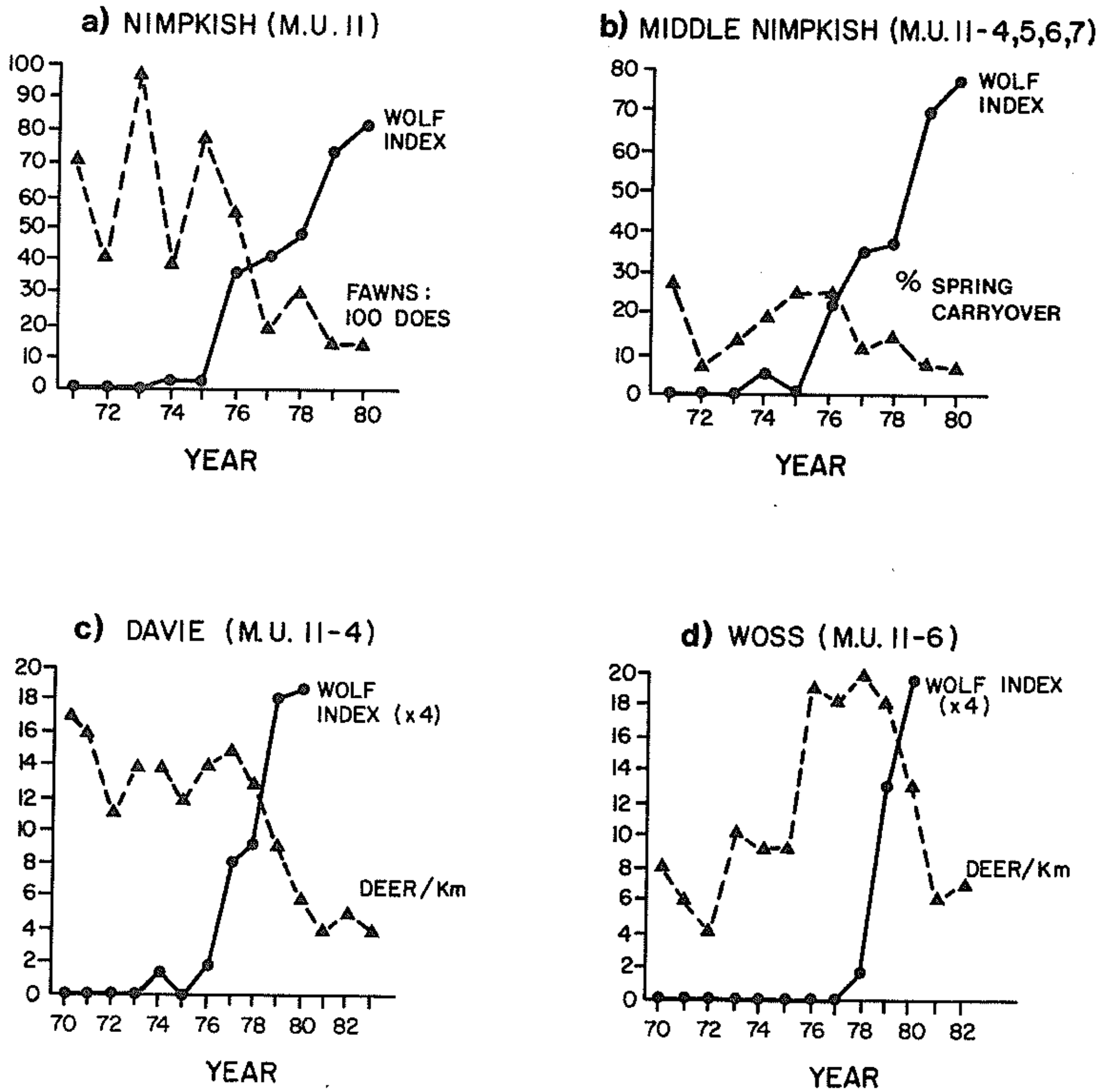

Figure 12. Relationship between (a) summer fawn:doe ratio; (b) spring carryover; (c and d) deer trends; and a wolf distribution index (% of spring deer transects having evidence of wolf use) in M.U. 11 (modified from Jones and Mason 1983). The summer fawn:doe ratio indexes fawn production and survival during the first two months of life.

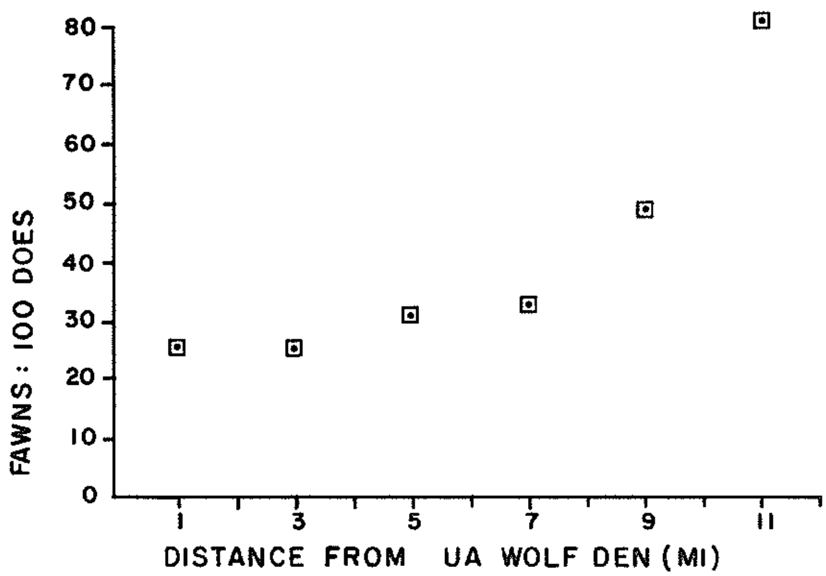

Figure 13. August fawn:doe ratios at varying distances from the Upper Adam wolf den-site (1980-81).

No relationship exists between cougar, bear, and deer population indices on the Island. A cougar hunter sighting index, cougar and bear predator complaints, as well as harvest trends of both predators, have not shown substantial increases to suggest they may be responsible for deer declines.

In the Adam River, fawns comprised a minor component of the black bear's diet. Only 7% of 406 summer bear scats in 1980-81 contained fawn remains (Hatter 1983). Eighty percent of the fawn occurrences were in June scats. Only 1 out of 26 deer fawns radio-collared during this period was killed by a bear. As this fawn was killed in June, bear predation appeared to be restricted to neonatal fawns and had minimal impact on fawn survival.

At Northwest Bay (M.U. 5 subunit 7), cougar-deer studies during the mid-1960's to the early 1970's indicate that cougar predation is not a significant mortality factor on deer and does not affect deer population trends (Dewar and Dewar 1975; Scott and Shackleton 1982).

Will habitat conditions support more ungulates?

Poor habitat quality and/or severe winter weather can lead to undernutrition, resulting in reduced natality, survival, and population declines (Klein 1970). On Vancouver Island, the quality and quantity of deer winter habitats are the most important factors responsible for maintaining nuclei of deer through severe winters (Hebert 1979). Neither of these factors, however, have contributed to the present deer declines.

In general, habitat quality is poorest on southern Vancouver Island where much of the deer habitat consists of dense second-growth forest, and best on northern Vancouver Island where mature timber-early successional forests provide suitable habitat (Hebert 1979, 1981). Despite habitat conditions, southern populations over the period 1976-81 were stable or increasing with equal or higher hunting pressure and similar weather patterns to the northern populations, but with lower levels of wolf predation (Fig. 3, 6). The largest deer declines on northern Vancouver Island have occurred in the Nimpkish Valley (M.U. 11), where major winter ranges have been deferred from logging. Declines have also occurred in unlogged watersheds (e.g. Claude Elliot, M.U. 10 subunit 16, Fig. 10).

Winter weather conditions on northern Vancouver Island have been relatively mild since 1971-72 (Fig. 14). The severe winters of 1968-69 and 1971-72 depressed deer numbers and spring carryover although populations rebounded quickly following these winters (Jones and Mason 1983).

The physical condition and birth rates of deer have remained high during the deer decline. Growth rates and mean age-specific weights of deer in the Adam and Eve watersheds in 1980-81 were comparable to or higher than those recorded from 1954-64 when deer populations on northern Vancouver Island appeared to be stable or increasing (Hatter 1983). Fetal rates of adult deer (167 fawns:100 does) were also similiar to deer herds examined prior to the increase in wolves (163-167 fawns:100 does) (Hatter 1983; Thomas 1983).

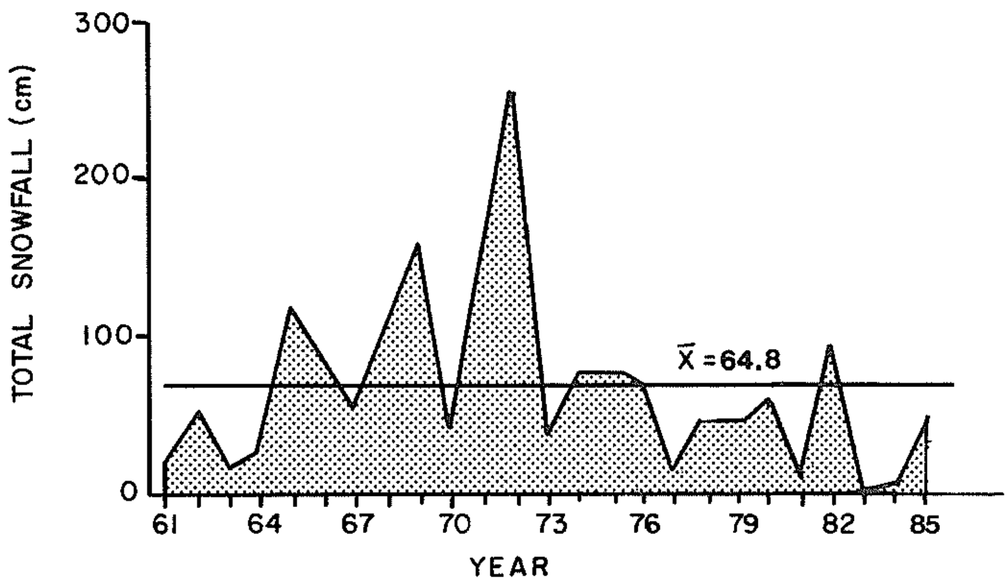

Figure 14. Total annual snowfall recorded at Port Hardy airport (November to April); 61 refers to 1960-61 winter, etc.

Will predator control increase ungulate numbers?

Numerous studies have indicated that predator control can increase ungulate juvenile survival and population growth (Austin et al. 1971; Beasom 1974; Guthery and Beasom 1978; Kie et al. 1979; Ballard et al. 1980; Bergerud 1980, 1983; Trainer et al. 1981; Stout 1982; Gasaway et al. 1983; Heimer and Stephenson 1984). Wolf control on Vancouver Island can also increase fawn survival and deer numbers as wolf predation is the only mortality factor that can consistently account for the present deer declines. Predation by black bears and cougars, and hunting are likely additive mortality factors but are not sufficient causes for the declines. Also, habitat and weather effects can not account for the declines. In addition, an experimental wolf control program in the Nimpkish Valley (M.U. 11) has increased fawn survival. Wolf densities have been reduced from approximately 4 per 100 km^2 when the project was initiated during the 1982/1983 winter, to 1 wolf per 100 km^2 in summer 1985. August fawn:doe ratios increased from 16 fawns:100 does in 1982 to 72 fawns:100 does in 1985. Over the same period, the fawn:doe ratios in the Adam River non-removal zone ranged from 11 to 26 fawns:100 does (Fig. 15). In 1986 spring carryover was 24% in the Nimpkish Valley and 11% in the Adam River.

Is wolf control economical and acceptable?

Management of the Vancouver Island wolf falls within the deer management prescriptions detailed in the Wildlife Management Plan for British Columbia: (6) reduce predator populations in key deer areas if predation is limiting deer production (Ministry of Environment 1980).

Shooting, trapping, and poisoning have been used to control wolves in British Columbia (Ministry of Environment 1979). Experience on Vancouver Island has indicated that regulated shooting and trapping are not effective. Harvesting wolves, through liberal bag limits and/or extended seasons, has not been effective in reducing wolf numbers sufficiently to stimulate deer recovery. An average of 40 wolves have been harvested annually on Vancouver Island since 1978. Shooting wolves by government personnel has also been unsatisfactory, since wolves can usually only be removed on an opportunistic basis, with a high commitment of both labour and funding. Aerial shooting is not feasible due to the heavy forest cover associated with coastal ecosystems.

Trapping by government personnel has been effective but limited to two research areas. In addition to the experimental Nimpkish project, wolves have been periodically removed in the south fork of the Nanaimo River (MU 5-3), study area of the Integrated Wildlife Intensive Forestry Research deer/habitat project. Thirty-five wolves have been removed from the area since 1982. There is little incentive for registered public trappers to remove wolves due to the low value of coastal wolf pelts. A few public trappers, however, have substantially reduced wolf numbers in specific areas, resulting in positive responses by the local deer herds. The White River deer population, for example, has increased since 1982 following the periodic removal of 10-15 wolves by a local trapper (Fig. 6c). In the Adam-Eve River area, 22 wolves were removed by non-government personnel from 1982-85 (Fig. 6b).

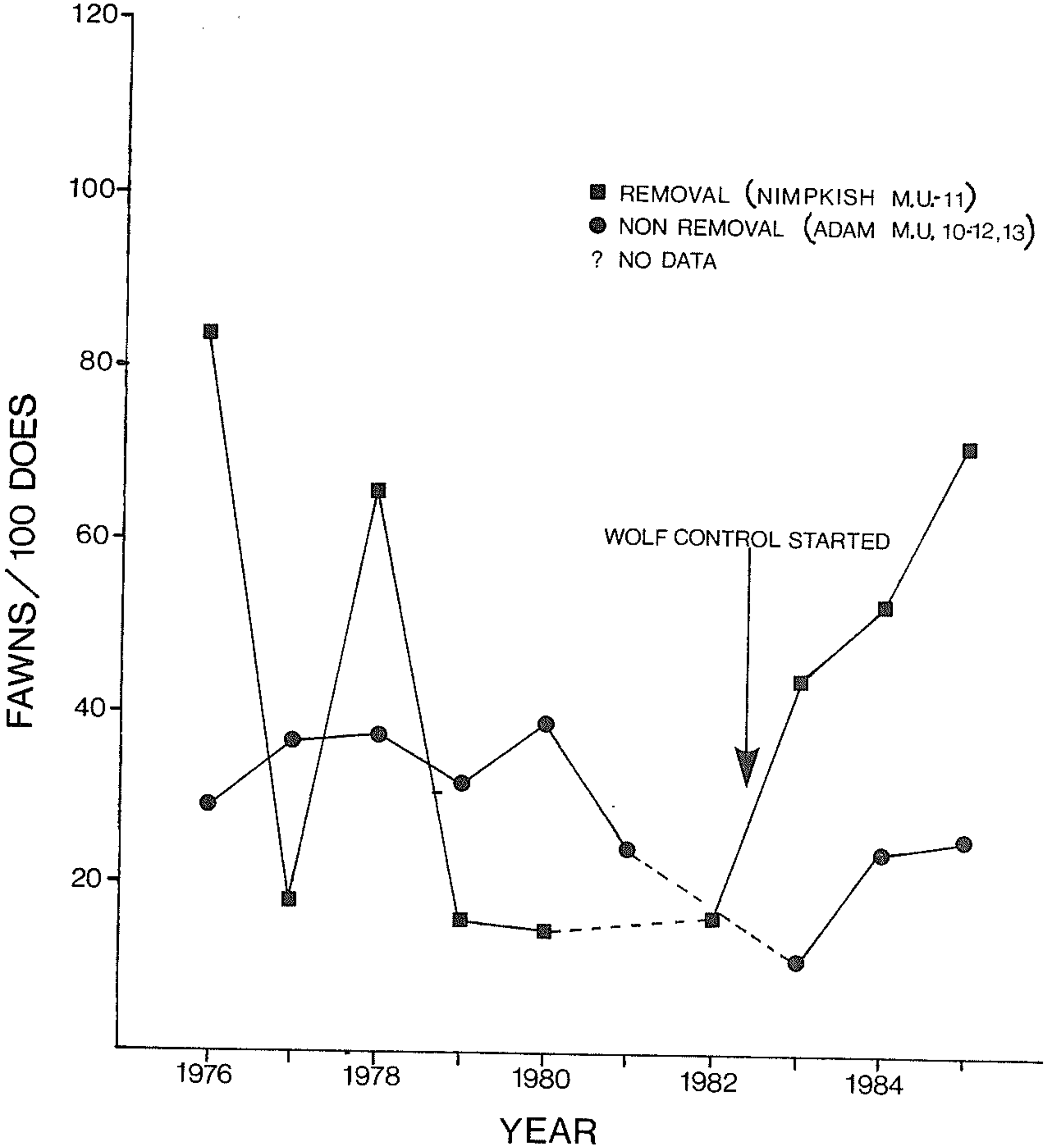

Figure 15. August fawns per 100 does in the removal and non-removal zones of the experimental wolf control project (from Atkinson and Janz 1986).

Poisoning is likely the single most effective control method for wolves on Vancouver Island. Sodium monofluoracetate (1080) is considered the most acceptable toxicant to use due to its selectivity for canids. Using small pieces (two to four ounces) of meat bait treated with one lethal wolf dose (13 mg 1080), the baits are completely safe to humans and other wildlife species similar in size to wolves. Burying baits reduces the chance of removal by small mammals and birds. Due to the dilution factor, secondary poisoning (feeding on a poisoned carcass) is virtually impossible. The hearing by the Environmental Appeal Board in 1980 on the use of 1080 for control of problem wolves and coyotes concluded that the use of poison as outlined by permit, posed little or no threat to the environment and was the most effective and economic method of predator control.

In addition to environmental concerns, opposition to the use of 1080 is often based on the claim that it is inhumane. Because 1080 is relatively slow in taking effect (two to three hours), however, does not imply it is less humane than faster-acting poisons or methods. As 1080 acts to inhibit glucose metabolism, there is a latent period of about two hours after ingestion during which symptoms are absent. This is followed by a 10-15 minute period of over-reaction (convulsions, etc.) prior to coma and death. Although pain in animals cannot be measured, recent research indicates the use of 1080 is a tranquil process in which the victim is oblivious to the external signs that distress human observers. Human victims of accidents or suicide attempts for example, reported no memory of convulsions nor did they feel any pain (F. Tompa, pers. comm.).

The use of 1080 would require Ministry staff or licensed private contractors to place and check baits and to retrieve unused baits in accordance with permit requirements. In addition, federal and provincial approval would be required, which may take up to two years prior to field implementation.

In the interim, and based on the results of the Nimpkish experimental control project, it is recommended that trapping efforts be expanded in attempts to reduce wolf numbers on Vancouver Island. The use of 1080 to control wolves is not recommended at this time, although it may be reconsidered if trapping is not found to be effective.

WOLF CONTROL - PROGRAM DESIGN AND EVALUATION

OBJECTIVES

The objectives of the wolf control program are to:

1. Reduce wolf numbers on northern Vancouver Island to 1 wolf/100-150 km^2 to allow recovery of important deer herds to meet stated objectives.
2. Initiate wolf reduction on southern Vancouver island as required to minimize deer declines and subsequent recover time.
3. Ensure the continued existance of wolves and the long-term maintenance of the predator-prey system.

LEVEL OF CONTROL

Previous wolf control programs have focused on reducing wolf numbers as much as possible to ensure positive benefits to ungulate populations. Little or no attempt has been made to determine the appropriate level of wolf control to meet both wolf and ungulate management objectives. As the dynamics of wolf and ungulate populations are strongly linked, wolf control programs should be directed towards managing predator-ungulate systems (Keith 1983).

Based on a hypothetical wolf-deer model (Hatter 1983), Figure 16 indicates the trade-offs between various levels of wolf reduction and harvest rates on the time required for a stationary deer population to double in size (a measure of its rate of increase). For example, if the hunter harvest removed 20% of the annual increment of the deer population and wolves were initially reduced by 30% and the resulting deer-wolf ratio maintained, ten years would be required for the deer population to double in size. If wolves were reduced by 80%, only four years would be required. The model also suggests that following intensive control, wolf numbers could be allowed to slowly increase to stabilize the deer-wolf ratio.

It is anticipated that wolf numbers will initially be reduced in the order of 80% to rebuild deer densities to 10-20 deer/km^2 over a relatively short period (5 to 10 years). The subsequent levels and periodicity of control will depend on how quickly wolf numbers increase following increases in deer density and how effectively normal trapping and hunting contain wolf numbers. It is anticipated that reductions of 30-40% of the fall wolf population may be necessary (Keith 1983). To assist deer recovery, all areas with wolf control will be subject to decreased deer harvests by cancelling antlerless seasons and reducing the bag limit from 3 to 2 deer.

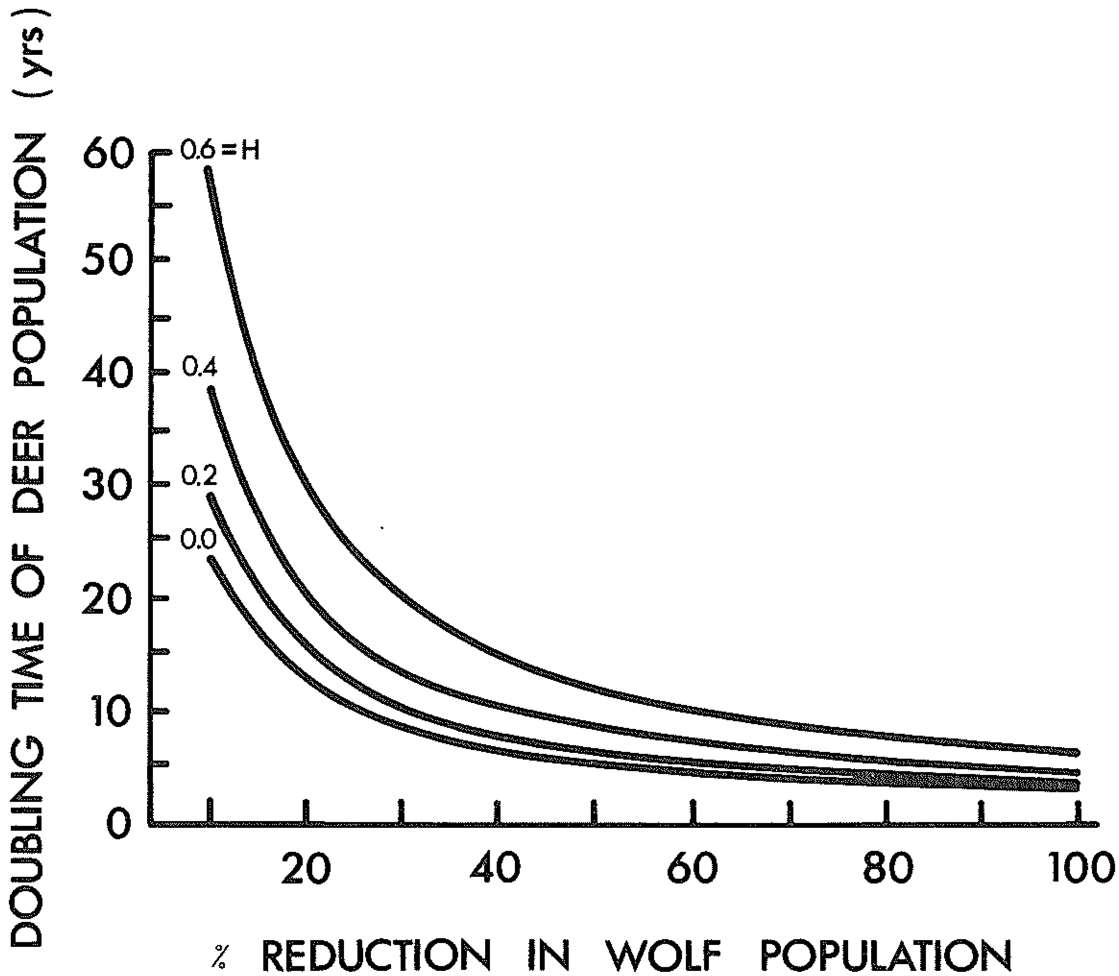

Figure 16. Rate of recovery of a hypothetical deer population with a potential annual growth rate of 30%. Several hunting rates and different wolf reductions from a stable deer-wolf ratio are shown. Rate of recovery is expressed as doubling time or number of years required for a deer population to increase two times in size. H refers to the proportion of the annual increment to the deer herd removed by hunting where the total increment is 100% (from Hatter 1983).

CONTROL AREAS

Standardized inventory techniques for wolves on Vancouver Island or elsewhere in coastal forests are virtually non-existent due to the dense vegetation. Population estimates are based on reported densities from research studies (Scott 1979; Hebert et al. 1982; Hatter 1983; Atkinson and Janz 1986), relative abundance as indicated by the wolf sighting index, and field observation by Ministry staff, woodworkers, and the general public. Estimated wolf numbers by management unit, and key watersheds requiring wolf control, are summarized in Table 1 and Fig. 17. Control efforts will be directed to accessible portions of watersheds on northern Vancouver Island (M.U.'s 9 to 13) to allow recovery of severely depressed deer populations, especially in areas where old growth winter ranges have been deferred from logging. Effort will also be directed to accessible portions of southern management units (M.U.'s 2 to 8) where evidence indicates deer survival is declining, but populations have not yet reached the low densities evident on northern Vancouver Island.

Due to limitations of access, 50-60% of the Island, especially in M.U.'s 8, 12 and portions of 13, will not be subjected to intensive control measures (Fig. 17).

CONTROL METHODS

At present, trapping is the only proven technique available to reduce wolf numbers on Vancouver Island. It is proposed that registered trappers be encouraged to trap wolves by supplying traps on a loan basis. Few trappers are willing to invest $100.00 per wolf trap due to the poor pelt value. In addition, some of the more proficient trappers should be hired on contract to ensure trapping efforts are directed at important deer herds and to allow trapping out of season, (i.e., post-denning period). Ministry staff would be available to offer training sessions and other assistance to interested trappers, in addition to conducting ongoing control activities. Following intensive control, removal through normal hunting and trapping seasons will be examined to see whether it is sufficient to restrict increases in wolf numbers.

EVALUATION

Wolves

The initial reduction in wolves will be recorded by trapper returns and evaluated by the reduction in the annual wolf hunter sighting index and estimated densities for those watersheds receiving wolf control. Subsequently, control efforts will attempt to maintain this index although as deer numbers increase, small increases in the wolf index will be allowed.

Deer

Five representative areas (Nimpkish Valley, White, Adam and Nanaimo Rivers, and Nanaimo Lakes) will be monitored annually to provide a detailed evaluation of deer population responses to the wolf reduction program.

Table 1. Estimated wolf numbers on Vancouver Island by management unit and major watersheds requiring possible wolf reduction activities, 1985.

M.U.	M.U. AREA (km^2)	ESTIMATED WOLF NUMBERS/M.U.	ESTIMATED DENSITY/M.U. (km^2/wolf)	KEY WATERSHEDS REQUIRING WOLF CONTROL BY M.U.	AREA OF WOLF CONTROL/M.U. (km^2)
1	833	<10	>150	None	0
2	914	10 - 20	46 - 91	Sooke, Shawnigan	460
3	2845	40 - 50	57 - 71	Caycuse, Gordon, San Juan	1070
4	1716	30 - 40	43 - 57	Cowichan, Nitinat	1200
5	2531	20 - 30	84 - 127	Chemainus, Nanaimo, Englishman	1710
6	2760	40 - 50	55 - 69	Oyster, Quinsam	980
7	2483	20 - 30	83 - 124	Ash, Franklin, Stamp	900
8	3693	20 - 30	123 - 185	Kennedy	280
9	2444	20 - 30	81 - 122	Gold, Heber, Ucona	1025
10	3547	60 - 80	44 - 59	Accessible watersheds	2270
11	2309	20 - 30	77 - 115	Kokish, Nimpkish	1900
12	3923	75 - 100	39 - 52	Accessible watersheds	1250
13	3908	75 - 100	39 - 52	Accessible watersheds	1950
	33906	430 - 590			14995

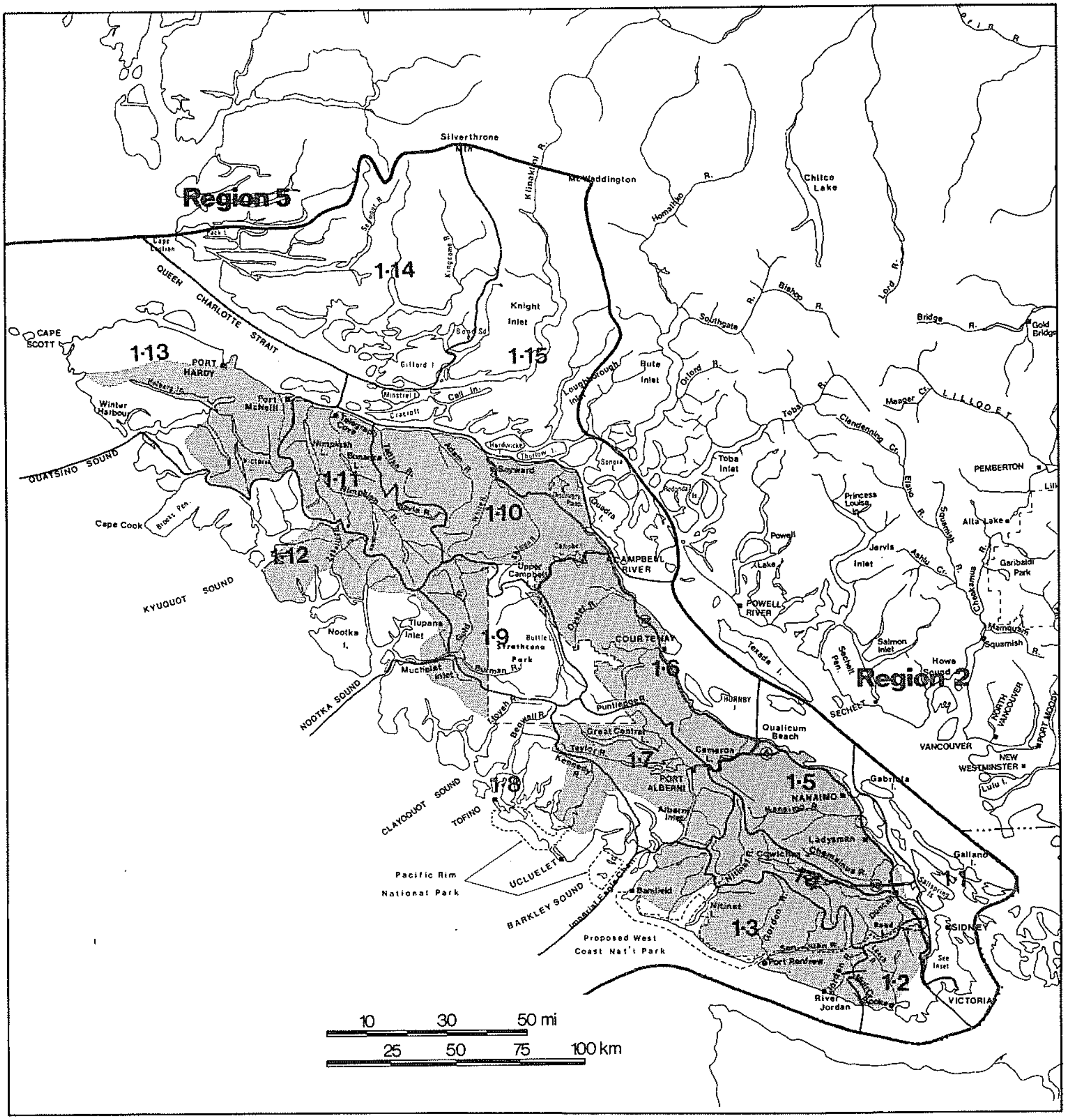

Figure 17. Areas on Vancouver Island requiring possible wolf reduction over the 1986 to 1989 period. Refer to Table 1 in text.

Population trends (deer/km index), August fawn:doe ratios, and spring carryover will be measured in each of these watersheds. In addition, the deer/km index will be measured annually in Sooke.

It is anticipated that several years may be required before positive growth rates can be measured from night counts (deer/km) for highly suppressed populations. Summer fawn:doe ratios and spring carryover will provide a more immediate indication of deer responses to the wolf reduction program. Studies on Vancouver Island indicate that about 25% carryover or 70 fawns:100 does in August should be sufficient for most deer populations to increase, assuming adult mortality decreases as fawn survival increases. Although high fawn to doe ratios do not ensure population growth, continued documentation of low ratios (<50 fawns/100 does, <15% spring carryover) will indicate little possibility of deer recovery, and a need for more intensive wolf control.

Costs and Benefits

The estimated benefits and costs of the proposed control program were subjected to economic evaluation to determine cost-efficiency by examining the recreational benefits to deer hunters (Reid 1986). There will no doubt be non-hunting benefits too but they cannot be effectively projected at this time. Benefits indicated are regarded as a minimum. Forecasts of deer harvest, hunter success, and recreational days with and without the control program were made for the period 1985 to 2000. With wolf control, the forecast predicted a 70% increase in the annual deer harvest, a 28% increase in hunter success (days/kill), and a 34% increase in hunter days by the seventh year of the program, as compared to similar forecasts with no wolf control. Even if the control program is fully effective in restoring deer numbers, the deer harvest and number of hunter days were projected to be less than the historical maximums recorded in the late 1970's due to habitat changes and reduction in the number of deer hunters as a consequence of reduced deer populations and increased hunting effort and costs. The value of the additional hunter days made possible by the control program was based on an average daily value of $31.20 for deer hunting on Vancouver Island (Reid 1985), discounted to the present at a rate of 8% per year. Costs of the control program, including research activities, supplying traps to registered trappers, and hiring trappers on contract, were estimated and converted to present values in a similar fashion.

The control program is expected to produce benefits with a gross value of almost $9 million (1985 dollars), at costs of about $250,000, for a net benefit of about $8.5 million (i.e. 36:1 = Benfits to Costs). As mentioned earlier, benfits associated with non-hunting activities of deer and elk were not evaluated, thus the value of benefits of the program is considered to be underestimated. Benefit:cost analysis and evaluation will be documented as the program proceeds to compare with the projected value of benefits.

Experimental Wolf Control Project

Results of the Nimpkish experimental control study, initiated in 1982, have substantiated that trapping can effectively reduce wolf numbers (Atkinson and Janz 1986). Deer population trend and juvenile survivorship in the removal zone also responded in a positive fashion to reduced deer density. Results in the non-removal zone are not as evident, as the experiment has been hampered by a fluctuating and often low number of wolves in this zone. Periodic removal of wolves by the local public is considered to be the major cause of declines in wolf numbers in the non-removal zone (Atkinson and Janz op cit).

Intensive trapping activities in the removal zone will terminate following the 1986 August classified deer counts. Periodic monitoring of wolf numbers and deer population trends will be continued however, to further investigate wolf-deer relationships. The information will also help establish predictive relationships between the wolf sighting index and wolf densities.

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