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EVALUATION OF INSECTS AND DISEASES WITHIN SELECTED FOREST STANDS ON THE NEZ PERCE AND COEUR D'ALENE INDIAN RESERVATIONS, IDAHO

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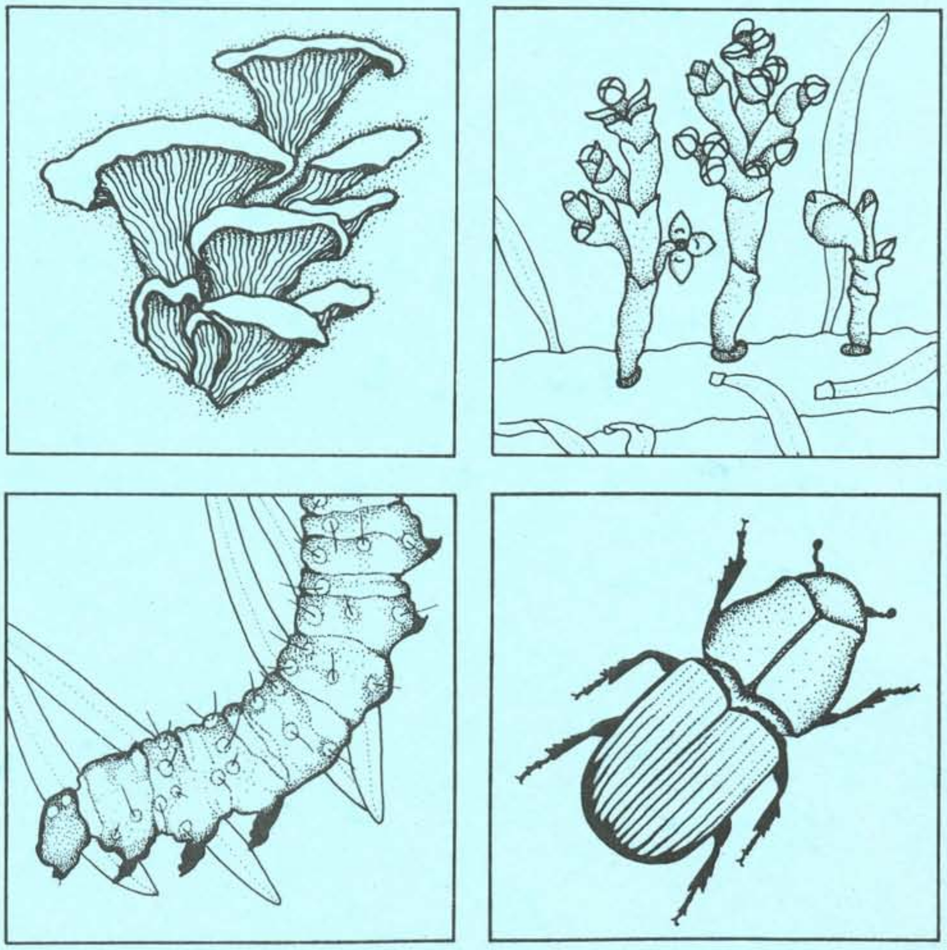

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ABSTRACT

Selected forest stands within the Nez Perce and Coeur d'Alene Indian Reservations in northern Idaho were evaluated for current insect and disease activity. Root diseases were the major pest problems on both Reservations. Large mortality centers caused by *Phellinus weirii* and *Armillaria mellea* occurred on the Coeur d'Alene Reservation; scattered *Armillaria* root disease was common on the Nez Perce Reservation. Other diseases observed included *Elytroderma* needle cast and western gall rust on ponderosa pine, dwarf mistletoe on Douglas-fir, and decay caused by the Indian paint fungus on grand fir. Major insects included mountain pine beetle on lodgepole pine and pine engraver and western pine beetle on ponderosa pine. Fir engraver and Douglas-fir beetle were associated with root diseased grand fir and Douglas-fir, respectively. Management strategies to reduce future losses are discussed.

INTRODUCTION

Tribal lands on the Nez Perce and Coeur d'Alene Reservations in northern Idaho are managed by the Bureau of Indian Affairs (BIA) often for maximum timber yields consistent with other land uses. Several of these timber stands have a history of previous cutting which resulted in removing most of the high value trees; less desirable species often occupied these sites. BIA foresters have recently emphasized management of forested lands on sustained yield principles for the long-term production of goods and services.

As forest management has intensified, concern for insect and disease losses has increased. Managers are especially concerned with identifying existing problems, and predicting what effects various management practices will have on potential future damage from pests. Therefore, an evaluation was made to ascertain insect and disease conditions within selected stands on both Reservations. These stands were either on general tribal land or allotment lands owned by several tribal members. Management direction was often different on the two types of land. For example, allotment lands are often managed to provide sustained annual yields of timber, whereas several stands on tribal lands require substantial investments to achieve sustained production.

The following discussion focuses on major diseases and insects encountered with particular reference to their biology as it applies to reducing future losses through proper management. Sites evaluated are listed in table 1.

Table 1. Descriptions of selected stands evaluated for insect and disease activity on the Nez Perce and Coeur d'Alene Reservations.

Site name	Legal description	Host-pest complexes evaluated
NEZ PERCE RESERVATION		
West Winchester Reserve	Sec. 36, T34N, R3W Sec. 1, T33N, R3W Sec. 6, T33N, R2	Root disease - Douglas-fir, grand fir
N. Winchester Reserve	Sec. 29, T34N, R2W	Pine engraver beetle - ponderosa pine Western pine beetle - ponderosa pine
Mud Springs Reserve	Sec. 16, T33N, R2W	Mountain pine beetle - lodgepole pine
Talmuks Allotment	Sec. 24, T33N, R2W	Elytroderma needle cast - ponderosa pine Western gall rust - ponderosa pine
Reubens Reserve	Sec. 20, 21, T35N, R2W	Root disease - Douglas-fir, grand fir Dwarf mistletoe - Douglas-fir Indian paint fungus - grand fir
COEUR D'ALENE RESERVATION		
Allotment 603	Sec. 27, T47N, R4W	Root disease - Douglas-fir
Allotment 44	Sec. 1, T45N, R5W	Root disease - Douglas-fir
North Alder Cr. Reserve	Sec. 6, T44N, R3W Sec. 1, T44N, R4W	Root disease - Douglas-fir, grand fir

Root Diseases

Root diseases are probably the most serious forest pests on both reservations. Losses were especially severe on the Coeur d'Alene Reservation where several large disease centers were located within Douglas-fir/mixed conifer stands. Surveys on adjacent lands within the Coeur d'Alene National Forest indicated that more than 12,000 ha (5.1%) of the commercial forest land was occupied by large active root disease centers discernible from aerial photographs (57). This probably represents only a portion of the root disease-infested area since not all root disease is visible from above-ground symptoms (53). Other surveys in northern Idaho (33,52) have confirmed that root diseases are common throughout many areas. Root diseases are important enough to require special consideration in the Idaho Panhandle (34) and Nezperce (3) National Forests management plans.

Two sites evaluated on the Coeur d'Alene Reservation (Allotment 603 and Allotment 44 - table 1) had several large root disease centers caused by the fungus Phellinus (Poria) weirii (Murr.) Gilb. This serious pathogen is common in the Pacific Northwest and Inland Empire where it causes extensive losses (8, 9). Most tree mortality occurred on Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco) and grand fir (Abies grandis (Dougl.) Lindl.); extensive brush invasion had occurred within disease centers. Mortality of young susceptible regeneration within disease centers usually occurred when their roots came in contact with P. weirii inoculum in the soil (7, 43). Up until that time, regeneration was often fast growing and appeared healthy.

Pockets of tree mortality occur because the pathogen usually spreads from tree to tree via root contacts (4, 8, 55). Disease centers enlarge progressively as long as susceptible trees are available for infection on the margin. Stands with extensive root disease may remain unproductive indefinitely if susceptible trees continue to regenerate disease centers (21, 43).

The other major root disease pathogen on the Reservations was Armillaria mellea (Vahl. ex Fr.), cause of shoestring root rot (41). This fungus was associated with mortality of Douglas-fir and grand fir at the North Alder Creek Reserve, Coeur d'Alene Reservation, and at two sites, West Winchester and Reubens Reserves, Nez Perce Reservation. On the North Alder Creek site, large extensive disease centers were common in stands partially cut 13 years ago. Some disease centers covered several acres; adjacent uncut stands had much less root disease mortality. Root disease on the Nez Perce Reservation was more subtle; mortality was mostly scattered and often located adjacent to windthrown trees. In all three areas, A. mellea was commonly located at the root collar of recently dead or dying trees. Several large trees had also been attacked by bark beetles, especially fir engraver (*Scolytus ventralis* LeConte) on grand fir and Douglas-fir beetle (*Dendroctonus pseudotsugae* Hopkins) on Douglas-fir. Association between root disease infection and bark beetle attack is common throughout the West (32, 33, 36). Apparently, root disease reduces tree vigor, thus predisposing trees to attack by bark beetles (11, 20, 29). This association, however, does not often occur in young trees which are rapidly killed by root pathogens (31, 32).

Although *A. mellea* was common on many root diseased trees, its role as the primary pathogen of mature trees is questionable. The fungus has an extremely wide host range (41); it often attacks trees that have been stressed by other abiotic or biotic agents (13, 55). *Armillaria* may sometimes be secondary and only a "symptom" of another problem. This has been demonstrated where the fungus is associated with other root pathogens, such as *Phaeolus schweinitzii* (Fr) Pat. (2) and black stain root disease (*Verticicladiella wagenerii* Kend.) (5, 30). *Armillaria* may increase its inoculum potential by saprophytically colonizing root systems of dead trees. The fungus may then be capable of attacking nearby live, healthy trees unaided by other predisposing factors (16, 50).

The large disease centers on the North Alder Creek Reserve demonstrate the problems associated with partial cutting in heavily root diseased stands. Since the initial cut in 1967, residual Douglas-fir and grand fir have continued to die from root disease. Although many sites have sufficient regeneration, mortality of Douglas-fir and grand fir seedlings has begun to occur, especially around stumps and recently killed trees. *Armillaria* often uses roots of stumps as food bases to build up enough inoculum potential to successfully attack adjacent regeneration (17, 31). Because of the relatively high level of current root disease mortality on the sites within the Coeur d'Alene Reservation, disease controls are necessary to return sites to productivity. Root disease levels on the evaluated sites within the Nez Perce Reservation are relatively low. Although direct control efforts are probably not currently warranted in these stands, root disease should be considered in silvicultural prescriptions involving Douglas-fir and grand fir.

Control Strategies

Future losses to root diseases within susceptible stands on the Nez Perce and Coeur d'Alene Reservations will be a function of management direction in areas where disease levels are high. In general, losses increase as management intensifies, especially if the number of stand entries are increased and root diseases are not considered in silvicultural prescriptions (3, 34). The following discussion focuses on management direction and alternatives available for reducing root disease losses.

Several guidelines have been prepared which discuss control strategies for reducing losses from root diseases (21, 49, 54). Most control options involve silvicultural manipulations to render stands less susceptible to indigenous root pathogens. Direct control by mechanical or chemical site treatment is expensive (18, 49) and may sometimes be ineffective (5).

Management options to deal with root diseases in commercial forest stands include:

1. If nothing is done, mortality will likely continue as disease centers enlarge. Centers will become occupied with brush and a few trees; productivity may be lost if centers regenerate with susceptible trees and mortality continues. Several disease centers may coalesce to form large, irregular patterns of mortality that may extend over large areas. If scattered root disease mortality is common, gradual loss of susceptible trees may be expected. Factors that contribute to disease center initiation are largely unknown. Therefore, development of expansive disease centers from initially scattered infected trees cannot currently be predicted.

2. Dead and dying trees can be salvaged. Although rates of disease spread and tree mortality will not be reduced by salvage operations, recovery of potentially lost wood will be possible. There is indirect evidence, mostly observational, that salvage cutting may aggravate root disease problems. Partial cutting probably helped accelerate losses of residual trees on the North Alder Creek Reserve. When mixed conifer stands are partially cut, more shade tolerant tree species are favored (51). Several of these species, particularly grand fir and subalpine fir, are often the most susceptible to root diseases (19, 21, 49). Therefore, partial cutting (individual tree-small group selection or light shelterwood) might be expected to enhance existing root disease problems, especially if susceptible trees such as Douglas-fir and true fir are left as potential seed sources. Verification of this hypothesis with field data is lacking; tests are being conducted to evaluate partial cutting effects on root disease activity. Species composition, stand age and vigor, levels of root disease and pathogens present, and important site factors such as soil characteristics, aspect, and habitat type probably all play a role in determining relative losses occurring from root disease (4, 21, 49).

3. Infested areas can be regenerated with site-suited, less susceptible species. Not all conifer species are equally susceptible to root pathogens (table 2). Many young stands can be grown to merchantability if disease tolerant species are favored. Less susceptible species can also be favored on the edges of and between disease centers.

If less susceptible species are not present in a root diseased stand, species conversion using clearcutting followed by planting desirable species may be necessary. Efforts to "get by" with species already present in spite of their high susceptibility to root disease have largely failed. If optimum timber production is to be realized, steps must be taken to convert diseased sites to a less susceptible condition; such steps may initially require high investments, but will likely result in greater long-term yields.

Table 2. Relative susceptibility of selected conifer species to *Phellinus weirii* and *Armillaria mellea* on the Nez Perce and Coeur d'Alene Indian Reservations. 1/

	Tree species 2/		
Pathogen	Most susceptible	Less susceptible	Tolerant or resistant
Phellinus weirii	DF, GF	SAF, WH	WL, WWP, PP, LPP, WRC
Armillaria mellea	DF, GF, SAF, LPP	WWP, WH, WRC	WL, PP 3/

1/ Most of the susceptibility ratings are based on field observations rather than experimental data. References for ratings include Filip and Schmitt (19), Hadfield and Johnson (21), Shaw and Roth (49), and Morrison (42).

2/ DF = Douglas-fir
GF = Grand fir
SAF = Subalpine fir
WH = Western hemlock
WL = Western larch
WWP = Western white pine
PP = Ponderosa pine
LPP = Lodgepole pine
WRC = Western redcedar

3/ Ponderosa pine may be susceptible when young but often develops resistance with age (42).

4. Experimentation in stopping marginal spread of root disease centers and reclaiming these sites for future production has been tried in several areas with varied results (5, 54). Procedures include removal of all trees and stumps for a 1- to 2-chain radius around well defined root disease centers. Stumps and major roots are then removed from centers if sites are to be regenerated with susceptible species. Such procedures are often very costly (49) and may fail because of the difficulty in determining relationships between above-ground disease symptoms and presence of root infection (5, 48, 49). Terrain may also limit application of these procedures.

5. Projected timber yields can be reduced. If future projections are based on restocking root disease centers with susceptible species, actual future yields may fall short of projections. Although valid

estimates of expected future yields within root diseased stands are unavailable, it appears likely that production will be drastically limited on sites known to be within currently active disease centers.

DWARF MISTLETOE

Douglas-fir dwarf mistletoe, Arceuthobium douglasii Engelm., occurred at several locations on the Reubens Reserve, Nez Perce Reservation. The parasite caused extensive brooming of large Douglas-fir comprising the overstory of mixed conifer stands. Some younger trees were also infected.

Dwarf mistletoes impact forests primarily through growth loss (14, 24), although tree mortality may occur (24). Growth loss estimates for dwarf mistletoe infected Douglas-fir on the Idaho Panhandle and Nez-perce National Forests (table 3) are probably similar to those on the Coeur d'Alene and Nez Perce Reservations.

Table 3. Growth loss of Douglas-fir caused by Arceuthobium douglasii on the Idaho Panhandle and Nezperce National Forests. 1/

National Forest	Percent stand infected	Volume loss ft^3/acre/yr	Volume loss M ft^3/yr
Idaho Panhandle	45	20	3,386
Nezperce	60	20	2,874

1/ Estimates not obtained from systematic surveys; such surveys to begin in 1981. Values are probably similar to losses on the Coeur d'Alene and Nez Perce Indian Reservations.

Trees of all ages and sizes are susceptible to infection (25). Losses are usually greater on poor sites within dense, slow growing stands (14, 24). Old growth stands on low productivity sites that were infected at an early age are most severely affected (3, 34). Risk of infection is directly related to previous fire and cutting history (23). If infected trees remain on a site after harvest, there is a good chance the new stand will become infected.

Dwarf mistletoe damage can effectively be reduced through silvicultural treatments. Seed tree and shelterwood treatments are suitable regeneration methods provided overstory removal promptly follows establishment of regeneration. Lightly infected trees may be suitable crop trees if they can be released through thinning. Infected residual trees should be removed from logged or burned stands shortly after regeneration occurs. Infected trees can be removed during thinnings. If heavy infection occurs within a stand, conversion to nonsusceptible species may be necessary, since dwarf mistletoes are generally host specific (24, 25). The above control strategies should be integrated into silvicultural prescriptions.

INDIAN PAINT FUNGUS

The Indian paint fungus (*Echinodontium tinctorium* E. & E.) was common on grand fir within the Reubens Reserve, Nez Perce Reservation. Although the fungus was mostly found on large, old growth trees, several small diameter trees were also infected.

The Indian paint fungus is common throughout the West and is considered the most serious decay fungus on true firs and hemlock (37). Decay and infection are usually more severe on river bottom sites than slopes and ridgetops (56). Factors such as crowded stands, shade, tree suppression, and moist soil and air probably contribute to greater infection on lowland sites (37).

Reducing damage caused by *E. tinctorium* usually involves sanitation and shortening rotation ages. Infection may occur through wounds (26, 38) or branch stubs (27, 56); recent research has indicated that infection can occur through small branches on young trees (15). Trees of low vigor are considered more susceptible (52). Therefore, maintaining thrifty stands through stocking control and limiting stand entries while avoiding damage to residual trees should help reduce damage by this fungus. Killing advanced regeneration that has developed under an infected overstory has also been recommended (37).

ELYTRODERMA NEEDLE CAST

Elytroderma needle cast, caused by the fungus *Elytroderma deformans* (Weir) Darker, was common on ponderosa pine (*Pinus ponderosa* Laws.) within the Talmuks Allotment, Nez Perce Reservation. The disease caused brooming and discolored foliage on infected trees. Levels of infection were generally low throughout the stand. *Elytroderma* is usually of little economic importance; infected trees are often only moderately affected (10). However, if trees are very susceptible and inoculum is high, severe effects on host growth and vigor may occur (46). The disease may also predispose trees to other mortality-causing agents (6, 46).

Removal of heavily infected trees during stand entries is usually sufficient to reduce losses from the disease (6, 10). Tree marking crews should become familiar with the disease and be able to differentiate it from dwarf mistletoe infection.

WESTERN GALL RUST

Western gall rust, caused by the fungus *Endocronartium harknessii* (J. P. Moore) Y. Hirat., occurred on ponderosa pine within the Talmuks Allotment, Nez Perce Reservation. This disease causes branch and stem malformations that usually resemble globose galls (44). No alternate host is involved; infection spreads from pine to pine (1).

The disease is often only of localized importance. Most loss is from killing small trees following bole infections. Susceptibility appears to be genetically controlled (28, 45); certain individual trees escape infection while nearby trees are heavily damaged. Removal of highly susceptible trees, i.e., those with numerous galls and bole infections, should improve overall stand resistance. Another important consideratio is ensuring the disease is not introduced in an area on infected planting stock (35).

MOUNTAIN PINE BEETLE

Mountain pine beetle (*Dendroctonus ponderosae* Hopkins) occurred on scattered lodgepole pine within the Mud Springs Reserve, Nez Perce Reservation. Trees were well spaced, with grand fir, Douglas-fir, and ponderosa pine invading the site to form an understory. A few trees had been successfully attacked during the last few years; several had resisted recent attacks. Mortality was generally scattered over a few acres.

Mountain pine beetle had previously been detected within portions of the Nezperce National Forest; during 1980 about 1,650 acres were infested (3). The insect is considered a potential pest to lodgepole pine stands with a mean diameter greater than 8 inches (12). Because phloem thickness has a positive effect on production of beetles, and tree diameter is positively related, stands with large trees are most susceptible (3, 12).

Apparently the stand at Mud Springs is near maturity and beginning to decline in vigor. Because of the preponderance of other, nonsusceptible species present in the area, managers plan to convert the site to a grand fir/Douglas-fir/ponderosa pine mixture by removing the lodgepole pine overstory.

PINE ENGRAVER

Pine engraver (*Ips pini* Say.) was observed on ponderosa pine within the North Winchester Reserve, Nez Perce Reservation. Insects apparently built up in slash and attacked nearby trees. Several portions of the Nezperce National Forest have encountered serious outbreaks of *Ips*, usually coinciding with drought years (3).

Most pine engraver beetle problems are associated with disturbances such as windthrow and ice breakage, drought in spring and early summer, thinning, logging, fires, road construction or housing development (22). Pine slash or weakened trees attract the beetles and provide ideal conditions for population buildup. Once beetles begin making attacks they produce pheromones (chemical messengers) that attract more beetles to the site, often increasing the number of attacks and killed trees.

Since overwintering beetles normally only infest green slash, logging or thinning slash created during the months of January through the end of June can be especially harmful by providing large amounts of breeding material. Ideally, slash should not be created during this time period unless it can be treated before the beetles emerge.

Percent of normal precipitation between April and July has been used to accurately predict intensity of Ips outbreaks (38). If moisture is 75% of normal or less, moderate to heavy tree mortality can be expected in overstocked, second-growth (up to 80 years old) ponderosa pine stands. Damage may continue 2 to 3 years. Under conditions of extreme drought large groups of young sawtimber, up to 30 inches d.b.h., have been attacked and killed.

Preventive measures for minimizing the mortality include:

1. Thinned, vigorous stands of ponderosa pine are less attractive to pine engraver beetle attack, particularly during drought years. However, recently thinned stands may temporarily be more attractive until the trees increase their vigor.

2. Pine slash should be minimized or not created during the months of January through June. If beetles do not have fresh slash in the spring, the population dies down.

3. The optimum time period for management activity in ponderosa pine where slash will be created is late August to December. Activity either earlier or especially later than this increases the potential for subsequent tree killing.

4. When it is not practical to avoid creating slash in the high risk months of January through June, several management practices can be used to help minimize the potential impact:

   a. Prompt slash disposal: Dozer trampling of slash is apparently effective in reducing the volume of breeding material; chipping is also very effective and especially useful in developed areas. When slash is burned, avoid scorching standing trees as this makes them very attractive to numerous species of wood boring insects.

b. Where general slash disposal is impractical, scattering the slash into openings where it is exposed to direct sunlight dries it out faster thus making it unsuitable for beetle development.

5. When beetle populations in slash constitute a threat, creation of a continuous fresh supply of slash during the flight period of emerging adults will generally attract the beetles keeping them out of the standing green trees. This technique is known as providing a "green chain." Slash should be created just as the beetles enter the pupal stage. Once this technique is started it should be continued for each generation of that season.

6. Logging operations can create many problems that lead to excessive killing of residual trees. Methods that may help reduce the risk are:

a. Trees whose roots are exposed or disturbed or that have large patches of bark knocked off should be cut and removed.

b. Fall trees into openings and use established skid trails to avoid damaging the residual stand.

WESTERN PINE BEETLE

Western pine beetle (Dendroctonus breviconis LeConte) was associated with pine engraver on ponderosa pine within the North Winchester Reserve, Nez Perce Reservation. Damage was minor; only a few larger trees were attacked. Western pine beetle commonly attacks old growth, stressed pine (40). Control usually involves removal of susceptible trees and maintaining stand vigor. Procedures listed for pine engraver control are applicable to the western pine beetle.

CONCLUSIONS

1. Root diseases are the major current and potential forest pest problems on the Nez Perce and Coeur d'Alene Indian Reservations in northern Idaho. Large disease centers caused by Phellinus weirii are common on the Coeur d'Alene Reservation. Armillaria mellea is common on both Reservations, although large mortality centers were only evident on the Coeur d'Alene. Bark beetles are often associated with root diseases. Root diseases should be considered in silvicultural prescriptions, especially in stands with a large Douglas-fir and grand fir component.

2. Other common forest diseases on the Reservations include dwarf mistletoe on Douglas-fir, Indian paint fungus on grand fir, and Elytroderma needle cast and western gall rust on ponderosa pine.

3. Major insects on the Reservations included mountain pine beetle (lodgepole pine), pine engraver (ponderosa pine), and western pine beetle (ponderosa pine); none were causing much damage.

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