Part 1: Pesticide Spraying Case Study

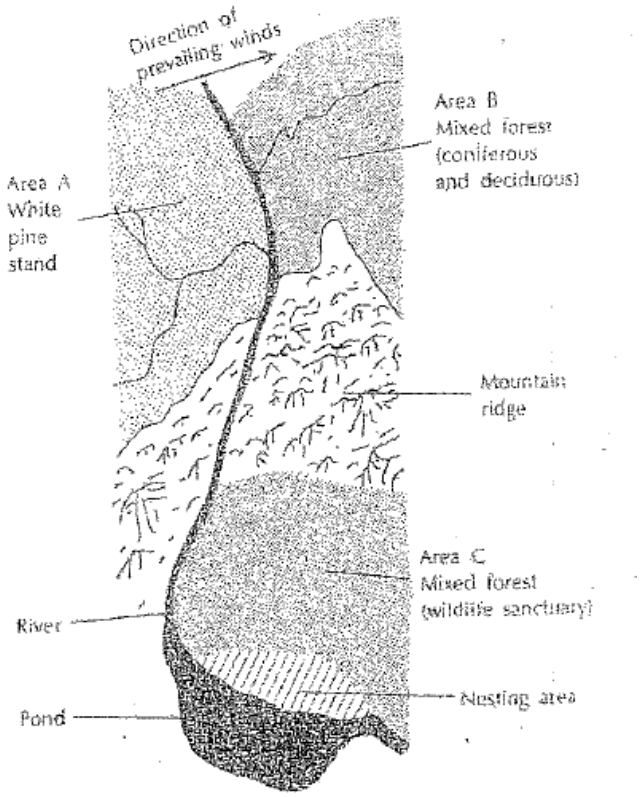

Figure 1 A Problem in Pest Control

An insect pest has attacked about 20 percent of the trees in a pure stand of white pine. In an effort to reduce his economic loss, the owner has his forest crop sprayed each spring with a relatively new pesticide.

The species that he is trying to eliminate is normally preyed upon by other insects, a parasite, and song birds from nearby woods. To the south of his property is a bird sanctuary for rare species of waterfowl and the carnivorous osprey.

He has been assured that natural barriers and the wind direction will keep the pesticide out of the wildlife area. The three areas shown on the diagram (Figure 1) were carefully studied over a five-year period by researchers from a nearby university.

Insect populations were estimated, fish and bird populations studied, soil samples collected, and pesticide concentrations measured in an effort to determine the overall environmental influence of this new pesticide. The results are recorded in Table 1.

Analysis: Use your graph and data table to answer these questions.

1. Plot a graph which shows the changes over time of the population of insect pests in each area: A, B and C.
    a. Why did the population of pests in Area A increase in 1978 when, in 1977, it appeared that the pest had been almost completely eliminated?
    b. What indication is there that Area C has not been directly affected by the aerial spraying of the pesticide?
2. Discuss the effect that the pesticide had on natural pest controls in each area.
    a. Which categories would be considered natural pest controls?
    b. How did this eventually influence the size of the population?
3. Consider the effect that the pesticide had on fish and bird species.
    a. Why is the concentration of pesticide so high in fish and bird species?
    b. What change in the concentrations of pesticide in the fish and bird life represent the point where significant change in mortality occurs?
    c. Suggest a food chain that would link the pine stand vegetation to the poor nesting success of the birds.
4. What method(s) could be used to remedy this “eco-mess”?
5. How did the use of this pesticide affect species diversity and therefore environmental stability?

Table 1: Pesticide Spraying Results

Year	Area	Insect pest population	Species of insect predators	% of pests with parasites	% fish mortality (adults)	Pesticide concentration in fish (ppm)	% nesting success	Insecticide in eggs (ppm)
1975	A	200,000	4	50	10	50	80	70
	B	50,000	7	30	10	50		
	C	50,000	8	30	8	30		
1976	A	4,000	2	10	10	150	25	170
	B	2,000	3	20	10	120		
	C	40,000	8	30	8	100		
1977	A	200	0	4	50	250	10	240
	B	1,000	1	10	40	200		
	C	40,000	8	25	10	150		
1978	A	800,000	0	2	80	400	4	300
	B	80,000	1	5	70	350		
	C	50,000	7	25	50	250		
1979	A	1,400,000	0	0	90	500	2	400
	B	100,000	0	3	90	450		
	C	50,000	7	30	70	300		

To conserve space, our **Conclusions** will be answered here:

11. Name two benefits for the use of commercially produced chemical pesticides:

12. Name two problems that are caused by the use of commercially produced chemical pesticides:

13. Name two benefits to the use of integrated pest management practices:

14. Name two problems caused by the use of integrated pest management practices:

Part 2: IPM (Integrated Pest Management) Plan

Integrated pest management involves the use of natural, plant-based alternatives to manage the wide variety of pests that reduce profits for farmers. Understanding the life cycle of your crop plants, and of their pests, make IPM efforts more successful.

Imagine that you are the owner of a small, 40-acre organic vineyard and apple orchard called Cove Landing in Front Royal, Virginia. Your apple crop has been steady, but you have been experiencing a reduction in profits for vineyard over the last 5 years as a result of pest infestation. You approach your local agricultural extension service to discuss your problem with a pest manager.

Your extension agent recommends that you try a chemical control, a biological control and a physical/cultural control for each type of crop that is being compromised. You are trying to save as much of your crop as possible, so you decide to try a combination of the methods to get the best results.

Use the information in Table 2 to help you develop a plan for integrated pest management at Cove Landing Vineyards.

Table 2. Vineyard and Orchard Pests

PEST	TYPE OF ORGANISM	METHOD OF DESTRUCTION	CHEMICAL CONTROL	BIOLOGICAL CONTROL	PHYSICAL/CULTURAL CONTROL
Apple Pests					
Spirea aphid	insect	attacks youngest leaves	insecticide 1	Ladybug (predator)	weed/litter cleanup crop rotation alley cropping intercropping companion planting
European red mite	arachnid	attacks fruit	insecticide 1 or 2	Ladybug (predator)	
green fruit worm	insect	bores holes in fruit	insecticide 1	Bt , small birds	
codling moth	insect	attacks fruit	pheromone traps	birds, bats	
powdery mildew	fungus	attacks leaves and bark	fungicide 1	none	
brown rat	vertebrate	attacks bark	rodenticide 1	dogs, raptor birds	litter removal/rat traps
white tailed deer	vertebrate	attacks bark, leaves and fruit	hot pepper spray	dogs	fencing
Grape Pests					
Spirea aphid	insect	attacks youngest leaves	insecticide 1	Ladybug (predator)	weed/ litter clean up crop rotation alley cropping intercropping companion planting
European red mite	arachnid	attacks fruit	insecticide 1 or 2	Ladybug (predator)	
Japanese beetle	insect	attacks leaves and fruit	pheromone traps	birds, bats	
dogwood borer	insect	bores holes into bark	insecticide 1	Bt , small birds	
rusty mildew	fungus	attacks leaves and bark	fungicide 1	none	weed cleanup/litter removal
eastern bluebird	vertebrate	attacks fruit	none	dogs, raptor birds	weed cleanup/litter removal
field mouse	vertebrate	attacks bark and fruit	rodenticide 1	dogs, raptor birds	litter removal/mouse traps

Some background information:

- ***Spring:*** Apple trees and grapevines blossom around the same time. When the petals fall, tiny leaves begin to emerge.
- ***Summer:*** Leaves mature and small, immature fruit begins to develop where the flower had formed.
- ***Fall:*** Fruits mature and grow to harvestable size. After harvest time, leaves drop and plants go dormant for the winter.
- ***Winter****:* Plants are still alive but are dormant, meaning there is no noticeable growth of foliage. Bark is exposed to elements, and sometimes branches may freeze and die.
- ***Bt*** stands for *Bacillus thuringiensis,* which is a microbial insecticide. T his is an insecticide that contains a bacterium that acts as a parasite.
- ***Pheromones*** are chemicals released into the environment in small amounts by many organisms. Through coevolution, insects and plants have adapted many similar attractants, either for mating or pollination.

6. Vineyards and orchards operate all year round. What are some things from the recommended list that you could do year-round to help control pests?

7. Most IPM plans involve seasonal practices that depend on the life cycle of crops and their pests. What are the first things you would likely do as the spring season gets under way to help protect your early growth with minimal environmental interference? Try to list in order of application.

8. Your apple trees are growing well and producing healthy fruit in early summer, but your grape vines look wilted and have little holes all over them. You also notice a preponderance of moth larvae and Japanese beetles have started to emerge. What could you do to protect your investment?

9. The European red mite has been found in several early apple samples. You want to use an insecticide, but you're not sure which one to select. Insecticide 1 is known to kill all insects with one or two sprayings, but it takes a bit long to break down. Insecticide 2 breaks down to harmless components very quickly, but is more effective on arachnids than Insecticide 1. You want to kill mites, but not the predatory spiders that inhabit virtually every outdoor arena. Which insecticide would you use? Justify your reasoning.

10. Explain how strategic plant selection, like crop rotation, intercropping or alley cropping, can help control the population of animal pests.