

3E453 – Pest Management Journeyman

Module 3, Lesson 3, Task 1 (10.12.1, 10.12.2, 10.12.3) Identify, Survey and Control Measures For Weeds Part 1

Slide 1.1 – Introductory Slide

Slide 1.2 – Lesson Title Slide

3E4X3 Career Development Course

10.12.1, 10.12.2, 10.12.3 Identify, Survey and Control Measures For Weeds Part 1

Slide 1.3 – Instructions

Welcome to Part 1 of the Identify, Survey, and Control Measures for Weeds lesson.

- Upon completion of the lesson, you must be able to successfully identify the relationship of basic facts and state general principles relating to identify, survey and control measures for weeds with at least 75% accuracy.

Overview

In this section, we will cover the following topics:

- Terrestrial Weed Pests
- Aquatic Weed Pests (Covered in Part 2)

Slide 2.1 – Overview Intro

Slide 2.2 – Overview

- Weeds are “plants that are out of place”. For example, a farmer who raises wheat takes pride in a good stand. Yet, the farmer’s wife will quickly extract the same plant from her daisy bed. On an Air Force base, there are areas where plants are desirable; including lawns, golf courses, road embankments, railroad rights-of-way, and runway shoulders. In these areas we manage the weeds.
- There are also areas where any vegetation is undesirable. Some of these areas include fuel, oil, and paint storage areas; certain buildings and shops; under fences; electrical substations; and along roads and railroads. Some vegetation control along drainage and irrigation ditches is also required.

- We will explore the types of terrestrial weed pests, their growth characteristics, identification, propagation, invasive species, management, control, and contingency operations.

Slide 3.1 – Types Intro

Slide 3.2 – Types

- Types
 - The three main categories of surface plants that you may have to control on your installation include woody plants, grasses, and herbaceous broadleaf plants.
 - Certain plants on Air Force bases have been planted or left alone to aid in base beautification or to act as wind breaks. In most cases, when left alone, these plants can become a serious problem along streets, fence rows, ditch banks, railroads, power lines, and water and sewer distribution systems.
 - WOODY PLANTS
 - Woody plants are plants that have thick trunks, relatively sturdy branches, and bark-like coverings. Woody plants include trees, shrubs, and vines. Trees are normally regarded as being large woody plants that have a single stem or trunk for self-support and several branches.
 - WOODY PLANTS
 - Shrubs have the same characteristics as trees but are generally not more than 10 feet tall. Vines are woody plants that climb or sprawl and do not have a self-supporting trunk. Woody plants have extensive root systems. Some of these plants have sprawling roots, others have a deep root system, and still others have both types.
 - GRASSES
 - Even though grasses are very beneficial to humans, they can become pests when they are in the wrong places. When this occurs, grasses become weeds and you must develop methods to control them. To do your job, you must be knowledgeable of the characteristics of grasses.
 - GRASSES
 - Grasses are plants that have long, thin, narrow leaves, and they usually grow more outward along the ground than upward. Regardless of whether the long, thin, narrow-leaved plant is tall or spread along the ground, you can recognize it as a grass if it has sheathing at each leaf base.
 - GRASSES
 - All grasses are monocots (they have only a single cotyledon). The cotyledon is a tiny leaf-like structure that emerges from the germinated seed. Grasses have fibrous root systems and tend to be both perennial and annual. Probably one of the best and most easily recognized characteristics of a grass is the parallel venation of the leaves.
 - HERBACEOUS BROADLEAF PLANTS
 - Herbaceous broadleaf plants have some general characteristics that you can use to separate from grassy weeds. When compared to grasses, most

broadleaf plants have relatively wide leaves. The leaves have netlike venation. In broadleaf plants, there are normally clusters of leaves at the ends of branches, and growth of the plants extends from growth nodes located at the end of branches.

- HERBACEOUS BROADLEAF PLANTS
 - Broadleaf plants are dicot, which means that two leaf-like structures (cotyledons) appear immediately after the seed germinates. The root system of herbaceous broadleaf plants is relatively deep and strong. The root system normally consists of a single taproot with many small lateral roots extending from it.
- Growth Characteristics
 - The most important growth characteristic of weeds is their ability to thrive in cultivated land. These features contribute to the successful growth of unwanted plants:
 - Underground roots or stems
 - Abundant seed production
 - Rapid growth
 - Competitive ability
 - UNDERGROUND ROOTS OR STEMS
 - Unwanted plants with underground roots or stems persist from year to year even though seed production is prevented. The underground parts of some plants spread in all directions, sending up aerial stem buds at intervals. These plants spread and actually favor cultivation, because cultivation spreads small pieces of roots over other areas.
 - ABUNDANT SEED PRODUCTION
 - Many plants produce thousands of seeds, and some of these seeds can live in the soil from 10 to 50 years.
 - RAPID GROWTH
 - Some plants can grow to maturity and set seed in only one or two months. Therefore, seeds are often formed before we can take adequate control measures.
 - COMPETITIVE ABILITY
 - Some weeds can overtake and retard desirable plants even though the latter have a head start. Therefore, they often win out over other plants for light. A few weeds have needs for mineral nutrients and water that exceed those of desirable plants. In addition, other weeds make the soil infertile by exuding chemicals which prevent the germination or establishment of neighboring plants.
 - IDENTIFICATION AND PROPAGATION
 - Plants are commonly identified as annuals, biennials, and perennials. The distinction between the various kinds has to do with their maturation and propagation. Other plants are known for the invasive and noxious qualities. Contingency operations will take you to the far corners of the earth where you will have to control pest vegetation.

- Annuals
 - Annuals are plants that mature in one season. Only seeds propagate them. Amaranths (Redroot Pigweed), crabgrass, foxtail, goathead, lamb's quarter, kochia, ragweed, sandburs, sunflowers, tumbleweeds, wild mustard, and shepherd's purse are examples.
 - CRABGRASS
 - Crabgrass is an annual plant that flourishes midsummer to fall. It is highly branched with the stem prostrate and rooting. The inflorescence is a terminal cluster of spikes. The seeds are slightly hairy.
 - YELLOW FOXTAIL
 - The foxtails are grasses of roadsides and waste places. They are striking plants because of their dense, cylindrical, spike-like inflorescence (flowers). This plant is distinguished by the tawny color of its spikes.
 - GOATHEAD/PUNCTUREVINE
 - Goathead is an annual weed that has horizontal stems that branch out from a central tap root. The branches develop secondary roots at the nodes. This plant has opposite leaves that are pinnate. When dry, the flattened fruit breaks into five nutlets, with two very strong, woody spines. The spiny spurs of this plant can penetrate tires. They have small yellow flowers that contain five yellow petals.
 - GOATHEAD/PUNCTUREVINE
 - This weed prefers to grow along roadsides and waste places. Goathead can also accumulate high levels of nitrate in the soil. Livestock grazing on infested fields can develop hepatogenous photosensitization from this plant's toxic characteristics. All growth stages of this weed pest are toxic, especially wilted plants.
 - LAMB'S QUARTER
 - This summer annual attains heights of up to 3 1/2 feet. The seedlings and mature plants have grayish-silver undersides with purplish fringes. The plant's main stalk has purplish nodes at the base of each leaf. Lamb's quarter is highly prolific and capable of producing thousands of seeds. Leaf shape is somewhat triangular. Young seedlings have a mealy gray cast. The leaves alternate from side to side. The root system is short and branches out in different directions.
 - KOCHIA
 - Mature kochia has the appearance of a small evergreen. The whole plant tapers to a point. These bushy plants can grow between 1 to 7 feet. The root system contains a deep taproot. They have straight multi-grooved stems that are light green. The plant has many branches. The plant is dark green when young and turns red as it matures. The seeds, when mature, are rough, flat, triangular, and grayish-black in color. During the fall, the plants often break away from the roots and tumble over the ground, dispersing seeds as they travel.
 - RAGWEED

- You have probably encountered ragweed sometime during your life. Ragweed is one annual plant that gives hay fever sufferers severe allergy troubles. This is an annual weed of rural and urban waste areas. The plant is erect and branched and, depending on the species, may be from 1 1/2 to 7 1/2 feet tall. The leaves are formed of leaf parts arranged feather-like along each side of a leaf stem. They show a great deal of variation from species to species. The yellow flowers are borne on tall spikes.
 - SANDBURS
 - Sandburs are a summer annual grassy plant that attains heights of about 24 inches. The blades of this weed pest resemble those of other mature grasses and differ only in that they are lighter green in color. Seed heads consist of a cluster of loose spiny burs held together on racemes. When disturbed the burs disperse individually. Mature burs stick to animal fur, shoes, and tires. This terrestrial weed pest will aggressively colonize open sandy soils along rights-of-way, ditch banks, and other disturbed waste sites in fields
 - TUMBLEWEEDS/RUSSIAN THISTLE
 - Although frequently associated with western movies, this plant originated in the steppes of Mongolia from a grain shipment. Tumbleweeds are notorious for breaking off from their root base and rolling whichever way the wind is blowing dispersing seeds. The plant itself is somewhat circular in shape and contains many sticklike branches. Leaves, stems, and stalk are grayish-green in color. When dry, the plant is a golden brown. Tumbleweeds thrive under harsh conditions and prefer saline soil conditions.
 - SHEPHERD'S PURSE
 - This weed is one of the most widely distributed weeds in the world. It can be either an annual or a winter annual (one that germinates in the fall, lives over winter, and matures early the next season) in lawns, gardens, or waste areas. The plant has a basal rosette of deeply toothed leaves, with a few arrow-shaped leaves on the erect stalk. The seedpods or "purses" are also on the stalk. The seedpods form from terminal white flowers, and they contain numerous yellowish seeds.
- Biennials
 - Biennials require two seasons to complete the reproduction cycle. Their growth period is longer than that of winter annuals. Since seed only propagates them, seedlings can be treated as the seedlings of annuals. Burdock, evening-primrose, common mullein, and yellow goatsbeard are biennials.
 - BURDOCK
 - Burdock is a biennial thistle that has dark green leaves. These plants can grow up to 18 inches tall. Mature leaves are somewhat coarse and egg-shaped while younger leaves are more heart-shaped. Leaf undersides are covered with fine hairs and appear somewhat woolly. This plant normally

has hollow leafstalks. Burdock flowers during the summer and autumn (July-October).

- COMMON MULLEIN
 - Common mullein is also known as Jacob's staff, torch plant, and flannel leaf. Common mullein is a biennial, and it produces its rosette of velvety basal leaves in the first year. In the second year, it sends up its stalk on which is a terminal spike of yellow flowers
- YELLOW GOATSBEARD
 - Yellow goatsbeard (Western Salsify), has a yellow flower about 1 to 2 1/4 inches across. The base of the flower has specialized pointed green leaves that are longer than the individual flower petals. They normally bloom between June and August. The leaves are similar to grass leaves and may be up to 12 inches tall. They have hollow-like stems below flower heads. When this plant is cut or disturbed, the wounds produce a white milky sap.
- YELLOW GOATSBEARD
 - They can attain heights of 12 to 35 inches and prefer to grow along roadsides, vacant lots, and edges of fields. They bloom early in the morning, but usually close by noon. They may remain open on cloudy days. The flower head follows the sun on its westerly course. When the seeds have formed, the flower head matures into a large "blowball" similar to that of Dandelions. The key difference is that goatsbeard blowballs are about 3 inches in size. The seeds disperse via the use of windborne sails.
- Perennials
 - Perennials are plants that live more than two years. Many have several means of perpetuation. They are provided with storage organs in the form of stolons (aboveground stems), rhizomes (underground stems), bulbs, crowns, and roots. The perennial weeds with creeping roots or stems are the most noxious. Supplies of food are laid up in these organs by the plant to feed a new growth the next year. The new shoot comes from a bud and lives on stored food until it becomes established.
 - Unlike the annual plant, the top growth of a perennial may be killed and still live and propagate itself because of its storage organs. To control perennial vegetation, the food reserves must be materially reduced or the storage organs destroyed. The food stored by the plant is the excess manufactured by the green leaves and stems over and above what is necessary for growth; therefore, if photosynthesis can be prevented, the buildup of reserves is curbed.
 - For control of perennials, the new growth is allowed to draw on food reserves until it becomes sufficiently established to manufacture its own food and then the top growth is killed. Buttercup, dandelions, johnsongrass, quackgrass, paperthorn, thistles, and yellow nutgrass are perennials.
 - BUTTERCUP

- This weed is most commonly found in shady, moist areas such as pastures, woodlands, and ditches. Notice that the stems are slender and branched from the base. The lower leaves are round, on long petioles, and the upper leaves are often divided into leaflets. The flowers are small and yellow.
- DANDELIONS
 - Dandelions are by far the most notorious turf-invading terrestrial weed pests. They are a highly prolific seed bearer, readily infest stressed turf landscapes, and are highly adaptive. They reproduce both through seed and cut root pieces. This cool season perennial usually emerges in early spring. They have a central taproot and form basal rosettes of narrow, deeply lobed leaves. These leaves are 2 to 10 inches long and up to 2 1/2 inches wide.
- DANDELIONS
 - The leaves contain jagged lobes that point back towards the central stem that allows moisture to flow towards the taproot. Dandelion flowers are yellow and grow up to 2 inches in diameter. The flowers are located at the end of a hollow stem that can grow up to 20 inches long. The flowers are typically higher than the leaf rosette. When mature, the flowers ripen to become round blowballs. The seeds readily disperse in the wind.
- DANDELIONS
 - These plants flower from early spring to late fall. They occur in most lawns throughout the growing season and are particularly fond of high-use, thin-turf areas. In areas where mowing is minimal they compete for sunlight against turf grass and other weeds and grow in excess of 1 1/2 feet. In areas where mowing heights are high and where frequent mowing takes place, the dandelion will grow shorter and produce short seed stalks. Thus, they can send out a new batch of seeds about every 7 to 10 days.
- JOHNSONGRASS
 - Another weed, johnsongrass is a perennial weed posing a serious weed pest in the southern states. It is 3 to 6 feet tall and has wide leaves with a thickened, light-colored mid-vein. The panicle (flower cluster) is loose and turns reddish at maturity.
- QUACKGRASS
 - Quackgrass spreads by developing circular vegetative mats containing dense rhizomes. This plant is capable of growing between 1 to 3 feet tall. It has bright green leaves with white to yellowish jointed rhizomes.
- QUACKGRASS
 - The rhizomes are capable of uplifting paved asphalt surfaces along rights-of-way (roadways, parking lots, airfield aprons, taxiways and active runways) causing extensive damage and posing as a foreign object damage (FOD) hazard. Quackgrass primarily spreads through rhizomes in existing infested areas. It spreads to other areas by producing seeds.

- PAPERTHORN
 - `Paperthorn (*Alternanthera caracasana*/*Alternanthera peploides*) is an aggressive perennial weed characterized by sharp spines located at every leaf node. This prostrate (horizontal/flat) branched plant forms dense mats in established turf lawns. It has a central root with additional roots extending from the leaf nodes that meet with the soil surface.
- PAPERTHORN
 - This weed pest has small hairy whitish flowers. Paperthorn favors roadsides, waste ground, and lawns and even thrives on heavily walked surfaces where it spreads via rhizome-like branches and sharp spines. The sharp spines are a nuisance sticking to animal fur, shoes, and vehicle tires.
- THISTLES
 - Thistles encompass a group of weed pests characterized by extremely sharp spines. A portion of the plant or the whole plant is protected by an arsenal of spines that discourage herbivores from feeding on them. Canada thistle is possibly the most noxious perennial weed in the United States.
- THISTLES
 - It grows up to 1 yard high, with grooved, hairy stems and irregularly lobed or toothed leaves. The root system is deep, wide, and spreading. The plant blooms in late spring and summer, depending on location, and produces small lavender flower heads.
- YELLOW NUTGRASS
 - Yellow nutgrass (nutsedge) is a perennial weed infesting lawns. Its name comes from the nutlike tubers found on the roots of the mature plants. The stem is a yellow-green color and triangular in cross section. When you look down on the plant, the leaves appear in three ranks, corresponding to the three sides of the stem.

Slide 4.1 – Invasive and Noxious Weed Pests Intro

Slide 4.2 – Invasive and Noxious Weed Pests Menu

- Overview
- Aerial Spray Operations
- Contingency Weed Control Operations

Slide 4.3 – Overview

- A great number of invasive and noxious weed introductions are the result of our own inadvertent transport of seeds, rhizomes, and actual plants from one location to another during our cargo movements. Contact your local county extension agency and Natural Resources Program Manager for additional information on the most prevalent invasive and noxious weed pests in your area.
- Also reference the United States (US) Department of Agriculture's plant database for additional guidance on invasive weed pests at the following web address: <http://plants.usda.gov/>. While some well-accepted local plants at your installation are

welcome, they may not receive the same reaction in another area where they take over the local landscape.

Slide 4.4 – Aerial Spray Operations

- Depending on your location, part of your responsibilities may include providing support to the 910th Airlift Wing (AW) out of Youngstown, Ohio. A portion of this wing's mission is to provide weed-free target zones to ease the removal of unexploded ordnance, create fire breaks, and treat for noxious weed pests.
- This entails applying thousands of gallons of herbicidal products to multiple aircraft target zones and other infested areas by using four specially-modified C-130H aircraft and modular aerial spray systems (MASS). Many aircraft target zones as well as other spray sites are located at bombing ranges, inaccessible areas, or areas that require many hours of driving time to get from one location to another. Therefore, it makes more sense to use the services provided by the 910th AW to reach these inaccessible targets in a short time span.

Slide 4.5 – Contingency Weed Control Operations

- Although weed controls usually have a low priority during contingency operations, use situational awareness to determine whether you have to implement weed control operations. Disease vector controls are usually your utmost priority during contingencies. Therefore, to accomplish disease vector controls, you must eliminate all possible harborage sites. This involves using integrated pest management (IPM) techniques in your control operations.
- Figures 4–23a and 4–23b illustrate a severe weed infestation at a deployed location where sand flies are prevalent. Your responsibility in this situation or similar situations is to eliminate the harborage sites by educating the facility occupants with proper sanitation standards—weed control and elimination. For security reasons, make sure you treat fence lines, weapon storage areas, and Hesco barrier hardened shelters during contingency operations or in garrison.

Slide 5.1 – Surveillance and Controls Intro

Slide 5.2 – Surveillance and Controls

- In this section we discuss details related to vegetation control. You will learn about both nonchemical and chemical controls for grasses and herbaceous broadleaf plants, as well as control measures for specific areas you may have to treat on your installation. Some plants are controlled through biological, mechanical, and chemical measures. Although the biological and mechanical controls are generally slower and more expensive than chemical controls, they should be implemented when and where possible to protect the environment.
- As you read this section, think about the weed problems you have on your base and look for classes or specific types of herbicides you could use. If you already have a weed control program, think about the herbicides you are using and ask yourself what characteristics make your chemicals suitable for your needs. Then compare your mental notes with what you learn in this section and see if you can come up with a better alternative.

- Determining the need to eliminate weeds takes into account the mission impact if the treatment is not completed. Gone are the days when you conducted weed treatments without regard to personal and environmental safety.
- Base all your pesticidal treatment action decisions on sound IPM techniques and mission impact determinations and not merely for aesthetically pleasing reasons. Use information collected during basic surveys to determine the right course of action when managing weeds—whether it is to limit, reduce, or totally annihilate the weed pests from a given area while protecting installation personnel and the environment.

Slide 5.3 – Terrestrial Weed Surveillance Menu

- Airfield Environments
- Installation Perimeter Fence Lines
- Weapon Storage Areas
- Electrical Substations
- Recreation Areas
- Industrial Areas
- Right-of-Ways
- Golf Course
- High Visibility Areas

Slide 5.4 – Airfield Environments

- Flightline paved surfaces include areas such as the active runway, taxiways, and aircraft parking aprons. Removal of airfield weeds can result in weed foreign object damage (FOD) hazard elimination.

Slide 5.5– Installation Perimeter Fence Lines

- Your installation and its outlying areas are enclosed by miles of perimeter fence lines. It is your responsibility to maintain perimeter fence lines weed-free. Weeds growing along fence lines impacts force protection and security.

Slide 5.6 – Weapon Storage Areas

- Weapon storage areas require all clear zones to be weed-free. Weeds found in or around weapons storage facilities can impact weapons safety.

Slide 5.7 – Recreational Areas

- Installations have several athletic fields which require annual broadleaf controls. Weed removal in these areas leads to physical safety hazard elimination (broadleaf weed stumps are a tripping hazard).

Slide 5.8 – Golf Course

- Golf courses provide a recreational value to your installation similar to athletic fields, but they are more costly to repair. Depending on your installation, your responsibility may be to help or maintain golf greens, fairways, and roughs. By removing weeds in these areas, you reduce the high cost of repairs as well as improve the overall aesthetics.

Slide 5.9 – Rights-of-Way

- No doubt your installation has a wide assortment of paved or concrete surfaces which require protection. Weeds, grasses, and other herbaceous plants can severely damage

these surfaces with their root systems. By removing weeds in these areas, you reduce the high cost of repairs.

Slide 5.10 – Industrial Areas

- Some plants have noxious or poisonous properties. By removing weeds in these areas, you contribute to the elimination of medical threats.

Slide 5.11 – Electrical Substations

- Areas surrounding electrical substations must be kept weed-free. Removing weeds around electrical substations leads to fire safety hazard elimination.

Slide 5.12 – High Visibility Areas

- Like golf courses, parade fields are your installation's pride and joy. They form an integral image of the condition of your installation in the eyes of your leadership. Maintaining them relatively weed-free is very important. Weeds in these areas lead to high cost of repair and issues with aesthetics

Slide 5.13 – Terrestrial Weed Controls-IPM

- The three integrated control measures available for controlling grasses and herbaceous broadleaf plants are mechanical, biological, and chemical measures. Although chemical control methods are most popular, most plants can be effectively controlled by employing multiple IPM weed abatement techniques. This lesson briefly addresses developing a terrestrial weed abatement program. Use previous surveillance information in the development of your IPM control program.

Slide 5.14 – IPM Alternatives

- Sanitation
 - Purchase weed-free grass seed or top soil.
- Fertilization
 - Use of proper nitrogen, phosphorus, and potassium to build-up turf.
- Watering
 - Adequate water quantities will encourage proper turf growth while over-watering will encourage the growth of fungi.
- Biological Controls
 - Use of natural enemies
- Mechanical Controls
 - Cutting, girdling, burning, mowing, and de-thatching.
- Cultural Controls
 - Soil rotation and tilling.
- Herbiciding
 - Use of contact killers versus soil sterilants, pre-emergents versus post-emergents, selective versus non-selective.

Slide 5.15 – Herbiciding Factors

When using herbicides to control terrestrial weed pests, consider the following factors.

- Soil Moisture Levels
 - Some herbicides require moist soils.
- Temperatures

- Increased temperatures increase intake, but also increase volatility
- Humidity
 - Herbicides enter the leaf more easily and rapidly in high humidity.
- Wind Velocity
 - Wind in excess of 8-miles an hour produces drift hazards.
- Precipitation
 - Decreases or negates the effectiveness of herbicide
- NOTE:
 - Complete all pesticide application activities only as a last resort after you have exhausted all other IPM measures.

Slide 5.16 – Nonchemical Controls Menu

Even though mechanical control methods are generally more expensive and slower than chemical methods, they are just as effective. Use biological controls on Air Force installations on a limited basis. Use both of these controls as part of your IPM arsenal.

- Mechanical
- Biological

Slide 5.17 – Mechanical Control

- Grasses and herbaceous broadleaf plants are controlled through mechanical measures if you implement the right measure at the right time. The methods you use should depend on the size of the area, type of terrain, and availability of equipment and operators. The proper mechanical control and the appropriate time for controlling plants depend on whether the plants are annuals, biennials, or perennials. The main types of mechanical control methods are cultivation, mowing, burning, and mulching.
- CULTIVATION
 - In most cases, cultivating is the most practical mechanical control for controlling annual and biennial weeds. The best results are when the area is cultivated shallow in early spring, and frequently thereafter until midsummer. This process reduces competition to desirable crop plants and prevents flowering and seeding.
 - Cultivating undesirable perennial plants causes the plants to starve because cultivation prevents the plants from manufacturing additional food. It also causes them to expend the food that is already stored within the plant. Controlling perennial plants through cultivation should be done shortly after the plants have produced new foliage.
- MOWING
 - Mowing is relatively effective for controlling some species of annual weeds if you mow often enough and before the flowers mature. Mowing should be conducted at a height that is low enough to remove the flora but high enough to still permit competitive ability.
- BURNING
 - Although burning is an unpopular word among environmentalists, it does have some merit in the control of undesirable vegetation. Fire is more effective for controlling annual plants than perennials. Burning is a useful mechanical control

measure for removing vegetation along fire breaks, waterways, railways, and security fences. Burning vegetation is popular in tropical regions because the ashes provide additional nutrients to the low-nutrient soils generally found in tropical regions.

- **MULCHING**
 - Mulching keeps light from the plants. Photosynthesis is thus reduced and the plants die or do not grow. Materials used for mulching include sawdust, hay, straw, manure, paper, and plastic. The area being treated must be completely covered with mulch. The layer of mulch must be thicker for perennials than for annuals. Deep-rooted perennials, such as morning glory plant, may require a layer of mulching material three to four feet thick.

Slide 5.18 – Chemical Controls - Classification INTRO

- As part of your IPM approach to managing weeds, you need to consider the use of chemicals as a last resort. Make every attempt to use other supplemental IPM techniques to preclude chemical usage. This portion of the lesson addresses herbicide classification as well as herbicide parent compounds.
- Frequently, herbicides in the same class have the same general use. Herbicides are grouped on the basis of use into selective and nonselective; mode of action into contact, translocated, and sterilant; and type of chemical compounds into arsenical, phenoxy, phenylurea, triazine, dinitro, benzoic acid, and aliphatic acid. Let us look at these groupings in more detail

Slide 5.19 – Biological Control

- Biological control is often the only control available for controlling weeds in inaccessible areas. Biological control of grasses and herbaceous broadleaf weeds includes use of certain insects, arachnids, fowl, grazing animals, and other plants.
- For biological controls to be effective, the predators or parasites introduced must feed only on the weed species you want to control. The predators and parasites you use in the control should not be a food source for other living organisms within the area. In addition, they must be adapted to the surroundings and have the ability to find the host.
- **FOWL**
 - Geese are used in many instances to control young weeds in such crops as cotton, strawberries, and mint.
- **GRAZING ANIMALS**
 - This concept is based on the placement of grazing animals that eat the plants you want to control in the infested area.
- **OTHER PLANTS**
 - Certain plants that produce selective phytotoxins have obtained some degree of success in controlling undesirable vegetation. For example, black mustard was planted in regions of California to inhibit the germination of chaparral, an undesirable range plant, but did not inhibit other range plants that were desired.

Slide 6.1 – Chemical Controls - Classification (Use) Intro

Slide 6.2 – Chemical Controls Classification (Use)

- Selective Herbicides
 - Selective herbicides kill certain weed species without seriously injuring the desirable plants among the weeds. Those that kill crabgrass or dandelions in a grass sod are examples. Certain herbicides kill broad-leaved weeds and not grasses, or vice versa.
- Nonselective Herbicides
 - Nonselective herbicides kill vegetation with little discrimination. Certain species, however, are resistant and escape. Resistant species are physiologically resistant to the chemical; some plants that escape are perennials that have part of their root system below treated layers of soil; others are annuals and shallow-rooted perennials that reinfest an area after the chemical has leached below the surface layer.
- Contact Herbicides
 - Herbicides in this class kill plant tissues that come in contact with the spray. Whether the plant dies or recovers depends on whether it has a protected growing point. Perennials usually have underground buds that will regrow. Contact herbicides include aromatic solvents and herbicidal oils.
- Aromatic Herbicides
 - The aromatic solvents are also called solvent naphthas or petroleum naphthas. They include a variety of petroleum and coal distillates that can be used in heavy concentrations for aquatic-weed control. Kerosene, especially as sold in the eastern United States; mineral spirits; tractor distillate; low-grade diesel oil; and similar aliphatic materials do not control submersed weeds.
 - The most effective products are those with a flash point above 80° Fahrenheit (F), distillation between 278 and 428° F, and an aromatic content of at least 85 percent. These solvents are highly flammable and irritating to the skin, eyes, and respiratory tissues.
 - Livestock tend to avoid drinking treated water. Vegetation is not harmed when irrigated with treated water. Aromatic solvents are deadly to fish. They are used in irrigation and drainage ditches, especially in short ditches (6–8 miles or less) with even sides and bottoms and with water flows of 1 to 70 cubic feet per second.
- Herbicidal Oils
 - Herbicidal oils are used as vegetation top killers, as solvents in the formulation of herbicides, and as carriers for herbicidal chemicals. You should not use oils that kill by contact as solvents or carriers of translocated herbicides, since a quick kill of the conducting tissue prevents translocation of the chemical. Oils vary widely

in their composition, value as an herbicide, and flammability. Generally, the toxicity to plants is greater with increased content of aromatics.

- Aside from composition, the value as an herbicide is influenced by some physical properties. If the boiling point is low, the oil may evaporate too rapidly; if too high, it does not penetrate plant tissues. The viscosity (or a liquid's resistance to flow) should permit use in cool weather. Specific gravity is important in aquatic-weed control. The flammability is indicated by the flash point; the lower the temperature at which an oil-vapor-air mixture ignites, the greater the danger of explosion.
- Oil sprays wet leaf surfaces and penetrates waxy leaf surfaces more effectively than water sprays difficult to wash off the plant and evaporates more slowly under high temperatures. The effect of oils on perennials is temporary. Oils are used for a quick kill of top growth—a chemical substitute for mowing. They penetrate the leaves of nongrass plants but kill grasses by creeping down the stem to the crowns and roots. Repeated treatments are necessary where seasons are long and rainfall is high.
- If relatively nontoxic, large volumes are necessary especially for oil-tolerant species, and aerial applications are impractical. Fortifying them with phenol compounds or using them in conjunction with soil sterilants can overcome some of the disadvantages of the oils used alone. The necessary volume can be reduced; the toxicity to tolerant weeds can be increased; a wider range of oils can be used; and the initial kill can be hastened, but the cost is higher.
- Fortified oil sprays, in low volume, are effective on small weeds. When plants, especially grasses, are tall enough to protect their crowns, larger spray volumes are required. Emulsions provide larger volume although they do not increase toxicity to plants. The oil content can be varied; 10 percent for easy-to-kill species and up to 25 percent for hard-to-kill species. Frequently, a fortified oil emulsion is more economical than a straight oil emulsion. Oils used as solvents or carriers may or may not be toxic to plants.
- Fortified oil emulsions are well suited for killing all vegetation on roadsides, ditch banks, and similar places and for spot treatments of shallow-rooted perennials. The staining that may result from oils carrying the dinitros when used on sidewalks and driveways is objectionable. Weed oils are preferred for such use and for oil-tolerant weeds. As a class, oils are insoluble in water; when mixed with water in the presence of a surfactant, they form an emulsion. The fortifying chemical is dissolved in either the water or the oil, or both.
- Translocated Herbicides
 - These chemicals are absorbed by the leaves and stems or by the roots, and move through the vascular system to leaves, buds, and root tips. When absorbed by the leaves and stems, the chemical is commonly moved with the food materials that were manufactured in the leaves and stems. When absorbed by the roots, the chemical moves in the water-conducting tissue.
 - The growth-regulator type of translocated herbicide is a synthetic compound that behaves like a plant hormone. It accumulates mostly in areas of rapidly

dividing cells upsetting the normal metabolism of the plant and causing death of the cells. Foliar applications of translocated herbicides are a great value, because small amounts are effective and they can be applied in small volumes of water.

- The foliage-applied nonselective herbicides are used primarily to kill weeds on land later to be cropped, but they also are useful on land where long residuals are not required, quick kills are needed, and weeds have survived or escaped control with a soil sterilant. Some of the selective herbicides remove broad-leaved weeds from grass sods, while others control grasses without severe injury to most broad-leaved plants. Use these herbicides in areas where the killing of vegetation for long periods is undesirable.
- Soil Sterilant Herbicides
 - This type of herbicide makes the soil incapable of supporting higher plant life; but it does not necessarily kill all life in the soil, such as fungi, bacteria, and other microorganisms. Its toxic effects may remain for only a short time or for years. Residual toxicity depends on the chemical and its rate of decomposition or leaching, colloidal and chemical content of the soil, species tolerance, and rate of application.
 - RATE OF DISAPPEARANCE
 - Soil sterilant herbicides vary in their rate of disappearance from the soil because of volatility, susceptibility to decomposition by soil microorganisms, and solubility. For example, some of the carbamates are volatile at high temperatures and rapidly lose their toxic effect during the summer months. Further, certain soil microorganisms effectively decompose some herbicides. Amitrole is soluble in water and leaches readily.
 - RATE OF DISAPPEARANCE
 - Some herbicides are readily absorbed by mineral and organic colloids and rendered unavailable or made slowly available for plant absorption. The fertility and potential of hydrogen (pH) of a soil are also influencing factors in the persistence or availability of toxic amounts of certain chemicals.
 - For example, monuron and diuron are absorbed on clay colloid particles so that leaching is difficult. Plants growing in soil low in nitrates more easily absorb sodium chlorate. Plant species vary widely in tolerance to soil sterilants, but heavy rates of application generally last longer than light rates
 - GREEN PLANT GROWTH
 - When present in the soil, sterilant herbicides prevent the growth of green plants. These chemicals are used in storage areas, lumberyards, and parking lots; on tennis courts; under pipelines, and in electrical substations. Additionally, they are used under guardrails and surrounding signposts on highways and lights on runways; near fire hydrants, trestles, and bridges; on utility rights-of-way; on gravel blanket areas; around

buildings, utility poles, and fuel tank farms; along fence rows; for firebreaks; and in similar areas where any plant growth is undesirable.

- There are two major problems in maintaining bare ground: no herbicide kills all species at reasonable rates of application and reinfestation results from weed seeds in the soil after the herbicide has been leached below the surface. Meet these problems by using a combination of chemicals effective against the weed species to be killed and by repeated applications of the proper herbicide to kill seedlings.

Slide 7.1 – Chemical Controls - Classification (Action) Intro

Slide 7.2 – Chemical Controls - Classification (Action) Overview

- The arsenicals are among the cheapest herbicides, but they must be handled carefully. Arsenical compounds are herbicides that are divided into two groups—inorganic and organic.

Slide 7.3 – Chemical Controls Classification (Action)

- Inorganic Arsenicals
 - The inorganic arsenicals include sodium arsenite, lead arsenate, and calcium arsenate. They are all highly poisonous to humans and other animals if swallowed. Since they are highly persistent in the environment, they are not commercially available. These compounds are derived from mineral elements, and due to their persistence (ability to remain stable for long periods), they are commercially unavailable.
 - WARNING: Inorganic arsenicals should not be used on military installations.
- Organic Arsenicals
 - These compounds are derived from plant and animal matter and are much less persistent than inorganic arsenicals. These organic arsenicals include disodium methylarsonate and amine methylarsonate. Both compounds are considerably less toxic to humans and livestock than the inorganic arsenicals, but they are harmful if swallowed. Both are applied postemergence for the control of crabgrass in turf.
 - WARNING: Many organic arsenical compounds are moderately toxic upon ingestion and moderately to relatively nontoxic through absorption; however, protective clothing and equipment must be worn, and there must not be any smoking, eating, or drinking during the handling of these compounds. Always ensure that these compounds do not contaminate any water source during or after application.
 - Never use these compounds as aquatic herbicides.
- Phenoxy Compounds
 - In their acid form, phenoxy compounds are only slightly soluble in water. For commercial use, they are formulated as esters, which form milky emulsions with water and dissolve in light oils or as water-soluble salts. The amines are the most widely used salts. They are easily soluble in water and are commonly sold in liquid form. There are also sodium and ammonium salt formulations that are

sold as water-soluble powders, but they are not as effective as the amine salts on hard-to-kill species or on weeds that are in the budding stage and beyond.

- All of the salts are practically nonvolatile. Two general kinds of esters are commercially available: relatively high-volatile esters and relatively low-volatile esters. Although the low-volatile esters vaporize less rapidly, both types are volatile at high temperatures. Drift can occur with any of the formulations if the spray is in very fine droplets or mist and there is a wind.
- The phenoxy formulations are moderately toxic. The hazard to livestock and wildlife is negligible on treated vegetation, but toxic amounts could be eaten if animals had access to undiluted concentrates or large amounts of spray mixtures. As ordinarily handled, these materials are not likely to cause irritation to skin or eyes.
- They are not absorbed through the skin to any appreciable extent and, in the amounts likely to be inhaled, are not hazardous. Neither is the ingestion of harmful amounts likely. As dosages used for weed control, they may harm fish in still, shallow water. They are noncorrosive and nonflammable.
- **Phenylurea Compounds**
 - These compounds are used for soil sterilants. They are only slightly soluble in water, they have a low volatility, and they are noncorrosive and nonflammable. They are formulated as water-dispersible powders and granular products. Except for the granular materials, all forms are applied as suspensions in relatively large volumes of water and require agitation in the spray tank.
 - Although these chemicals do not move far laterally in the soil, they may be washed down the surface slopes to kill vegetation below, and they leach deeply enough to reach the roots of trees, shrubs, and the deep-rooted plants growing under the treated area. All these chemicals can irritate your eyes, nose, throat, and skin.
- **Triazine Compounds**
 - Triazine compounds are soil sterilants when applied at high rates. They are noncorrosive and nonflammable, and present no electrical or conductivity problem around utilities, power plants, transformers, signal blocks, or other electrical installations.
- **Dinitro Compounds**
 - These compounds are contact herbicides used alone and to fortify oils. The parent compounds do not dissolve in water but are soluble in oil. Sodium, ammonium, or amine salt formulations are water soluble. The Weed Science Society of America (WSSA) designates the three parent compounds as dinitros: 2-(1-methylbutyl)-4,6-dinitrophenol (DNAP); 2-(1-methylpropyl)-4,6-dinitrophenol (DNBP); and 2-methyl-4,6-dinitrophenol (DNC).
 - **WARNING:** All three dinitro compounds are yellow dyes that stain skin, hair, and clothing. They are highly poisonous if swallowed, if absorbed through the skin, or if any appreciable amount of spray mist is inhaled. Although they are not irritating, they are readily absorbed through the skin. Keep them away from heat and open flame.

- The dinitro parent compounds are used nonselectively for top kills of vegetation. The sodium, ammonium, and amine salts are used selectively. The parent compounds are very effective contact herbicides that control a wide range of herbaceous plants, including many oil-resistant plants.
- They require large amounts of water, and their effectiveness as weed killers varies widely with the temperature. The dinitros are not economical to use on perennial grasses and on coarse, vigorous, annual grasses. Repeated applications are required for control in areas of long seasons and high rainfall. DNBP is the most effective form; DNC, the least effective; and DNAP, the intermediate.
- Benzoic Acid Compounds
 - These compounds are readily translocated in the plant. They kill through both root and foliage absorption. They are good temporary soil sterilants for both perennial and annual weeds.
 - NOTE: When handling these compounds, wear protective equipment and clothing. Avoid drifts so that desired vegetation will not be affected and water sources will not be contaminated.
- Aliphatic Acid Compounds
 - These compounds are relatively strong acids and are primarily used as herbicides. They are derived from sodium salt and are usually obtained in powder or pellet forms. They are water soluble and are used principally as selective, translocative, preemergence, and postemergence herbicides.
 - NOTE: Do not apply these compounds near desired vegetation or irrigation water or when heavy rains are expected, because these compounds have a tendency to leach out of topsoil. Wear protective clothing and equipment, avoid drift, and wash spray equipment immediately following use because these compounds are very corrosive.

Slide 7.4 – Herbicide Precautions

1. Identify the weeds you want to control.
2. Select the right herbicide to control the weeds without harm to desirable plants nearby.
3. Read the herbicide label.
4. Select the proper equipment.
5. Mix the chemical according to mixing directions. Do not use more than recommended amounts.
6. Plan to apply the materials according to the label directions.
7. Follow all safety precautions on the label. Let us look at why these actions are important..

Slide 7.5 – Herbicide Precautions Menu

- Protecting Desirable Plants
- Turf
- Herbicide Labels
- Protecting Game and Fish
- Protecting Areas

Slide 7.6 – Protecting Desirable Plants

- Certain precautions are necessary to prevent damage to nearby beneficial plants. This damage may result from drift, washing, or leaching.
- **DRIFT HAZARDS**
 - Remember, drift hazards are greatest when herbicides that affect the leaves of plants are used. These are the growth-regulating type or contact type. The danger is mitigated when liquid applications are made with nonvolatile herbicides at low pressures. Keep in mind that drift occurs not only with volatile herbicides, but also from a high-pressure sprayer that atomizes herbicides into mists.
- **WASHING**
 - Washing is an important hazard on slopes, bare ground, and pavements. The herbicides are carried by surface runoff to valuable plants downhill. Do not drain or flush equipment where runoff to desirable plants may occur.
- **LEACHING**
 - Leaching moves chemicals downward through the soil. If the chemicals are readily absorbed by roots, plants whose roots extend under the treated area are likely to be injured. Avoid treating such areas with soil sterilants. Do not drain or flush equipment where leaching to the roots of desirable plants may occur.

Slide 7.7 – Protecting Game and Fish

- Most herbicides are less dangerous than insecticides to wildlife. There are a few, however, such as the arsenicals and dinitros, which can poison animals. Most injury results from overdoses and spillage. Indiscriminate spraying and spraying that results in defoliation of vegetation can destroy cover, but herbicides can also be useful in management.
- Openings in wooded areas, such as the clearing for utility company rights-of-way, and spraying hardwoods in stands of pine can be beneficial to wildlife. A few herbicides are very toxic to fish, but many can be used safely for the control of aquatic weeds.
- Approved chemicals may be applied in the form of sprays or granules. Porous bags that contain chemicals can be dragged through the water until the chemical has dissolved. Chemicals can even be applied over iced areas in the same manner you would treat a field. As the ice melts, the chemical is released slowly into the water. Copper sulfate, if applied correctly, can be used and is very effective for controlling algae. Aromatic oils are also often used for controlling aquatic weeds in irrigation canals.
- The control of submersed weeds in ponds or streams can be beneficial to fish population. Safe amounts of herbicides, expressed in parts of the chemical per million parts of water, vary widely with the age, size, and species of fish. When a proposed spraying program might endanger game and fish, consult the federal or state fish and wildlife service for advice

Slide 7.8 – Protecting Areas

- There are specific areas on and adjacent to Air Force installations where partial or complete vegetation control is required. Some of these areas are in and around highways, roadsides, utility lines, and railroads. In addition, weed control must be

effective in turf areas, such as lawns, athletic fields, golf grounds, parade grounds, and so forth.

- **PAVED HIGHWAYS**
 - Vegetation that encroaches on the edges of asphalt pavement or grows up through cracks and holes causes premature breakdown of the pavements. You can control this type of vegetation with pre-surface and post-surface application of herbicides.
- **PRE-SURFACE APPLICATION**
 - Shoulders next to the roadway, medians separating divided highways, and islands at highway intersections are often surfaced with asphalt. On such areas, apply the herbicide to the gravel base just before the asphalt is poured. A standard highway watering truck can be adapted for this use by equipping it with a loading pump to circulate the spray material and with standard asphalt nozzles that deliver a fan spray.
 - Several herbicides prevent the emergence of plants through the pavement, but they vary in cost and in injury to vegetation next to the pavement. Plant growth on the unpaved area, particularly on fill slopes, may be desirable to prevent erosion.
- **POST-SURFACE APPLICATION**
 - Post-paving treatments are necessary later to prevent encroachment from unpaved areas and to control any vegetation growing up through cracks in old pavements.
- **ROADSIDES**
 - Herbicides are useful in the maintenance of roadsides if they are properly applied. The greatest danger comes from drift, runoff, improper application, and leaching to roots of desirable species under the treated area. Before spraying, make a survey of the area, spotting any slopes subject to erosion, the location of desirable vegetation, and the density and height of brush.
- **REDUCE MIST**
 - It is especially important to reduce mist when you spray with a handgun. Operate at low pressure—30 to 60 pounds per square inch (psi). Direct spray downward as much as possible and do not spray when it is windy. When you are treating edges of roads, spray from the outside toward the pavement.
- **RUNOFF**
 - Runoff is an important hazard on slopes, bare ground, and pavements. Cutback asphalt applied with a soil sterilant helps to hold the chemical in place. Use 39 gallons per 1,000 square feet, or 1,700 gallons per acre, or use a light covering of road oil. If there has been an excavation, add a layer of crushed rock. Trees and shrubs some distance from soil treated with soil sterilants may be killed if their roots extend below this area.
- **UTILITY LINES**
 - Make two complete sprayings of all transmission lines at two-year intervals—the first to kill as much growth as possible and the second to kill escapees and

resistant species. Spray only those species that grow tall enough to interfere with the lines. If the plants are over 6 feet tall, cut and spray the stump.

- Fenuron pellets at a specific rate per acre of active ingredient, kill alder, blackberries, and sumac; elderberry, elm, hawthorn, maple, and willow are not killed, but all species are defoliated. Foliage sprays control many species of hardwood brush throughout the season. They are most effective when applied soon after leaves are fully expanded and when the plants are growing actively.
- RAILWAYS
 - The three primary areas on railways on which weed control is necessary are the ballast, roadbed, and rights-of-way. The ballast is a strip 12 to 16 feet wide, made up of coarse material, such as cinders or gravel that should be kept free from weeds. Because the ballast is so porous, it does not retain chemicals well. Insoluble herbicides, those absorbed through leaves, and contact herbicides are most suitable.
 - The roadbed (berm) beyond the ballast requires weed control, but elimination of vegetation increases erosion. The rest of the area to the right-of-way fence is similar to roadsides. If control is effective during the first two years by heavy rates of application, it can be maintained with reduced rates thereafter. The effectiveness of some soil sterilants, like diuron and simazine, may not show up until the second or third year of use, especially in dry areas or with deep-rooted weeds.

Slide 7.9 – Turf

- Turf weeds comprise broad-leaved species that can be killed with one group of herbicides without seriously injuring turf grasses and undesirable grasses that can be controlled by a second group of chemicals. The morphological and physiological differences between broadleaf weeds (dicotyledons) and grasses (monocotyledons) make selective control possible. Weedy grasses are removed from turf grasses with selective herbicide. Use herbicide if the weed is an annual and the turf grass is a perennial.
- Weeds in lawns, athletic fields, golf grounds, parade grounds, the turf portions of roadsides and railroad rights-of-way, and similar areas are controlled by good maintenance practices supplemented with chemical herbicides. It is important to prevent the encroachment of weeds by maintaining competition from vigorously growing turf grasses. The principal factors in maintenance are soil, grass, water, mowing, and pests.
- Both the physical and chemical properties of the soil are important. Adequate organic-matter content, drainage, and aeration are as essential as proper fertility. The selection of the grass or grasses to be seeded is also important. Each type has its requirements for optimum adaptation. Water not only keeps plants from wilting, but also is a nutrient and acts as a solvent and carrier of nutrients and food.
- The frequency and height of mowing are important. The height is determined by the kind of grass, and the frequency depends on rate of growth. Pests include insects,

diseases, and weeds. These often require treatment beyond good maintenance practices. Insecticides, fungicides, and herbicides are supplementary controls.

Slide 7.10 – Herbicide Labels

- Labels on the herbicide container are written with great care to state only facts. Recommendations on labels for materials sold interstate must be registered with the Environmental Protection Agency (EPA) before the label can be authorized. Always read the label. It tells, first, what the herbicide is. For instance, 2, 4–D is sold as sodium or amine salt or volatile or nonvolatile ester.
- Recommendations differ for various herbicides and for various formulations of the same basic chemical. The label tells you the amount of acid equivalent, phenol equivalent, or active ingredient in the product. This information helps you compare the concentrations in various formulations. The label also gives you use recommendations and rates and time of application. Certain warnings are stated when necessary to protect you from accidental poisoning or irritation by the chemical and to protect susceptible plants from injury.

Slide 8.1 – Course Completion

Congratulations, you have completed the identify, survey and control measures for weeds part 1 of 2 lesson. Please click complete lesson to receive credit.

3E453 – Pest Management Journeyman

Module 3, Lesson 3, Task 1 (10.12.1, 10.12.2, 10.12.3) Identify, Survey & Control Measures for Weeds Part 2 of 2

Slide 1.1 – Introductory Slide

Slide 1.2 – Lesson Title Slide

3E4X3 Career Development Course

10.12.1, 10.12.2, 10.12.3 Identify, Survey & Control Measures for Weeds Part 2 of 2

Slide 1.3 – Instructions

Welcome to Part 2 of the Identify, Survey, and Control Measures for Weeds lesson.

- Upon completion of this lesson, you must be able to successfully identify the relationship of basic facts and state general principles relating to Identify, Survey, and Control Measures for Weeds with at least 75% accuracy.

Overview

In this section, we will cover the following topics:

- Terrestrial Weed Pests (Covered in Part 1)
- Aquatic Weed Pests

Slide 2.1 – Aquatic Weed Pests Intro

Slide 2.2 – Overview

- Aquatic vegetative pests are making a comeback. Our current protective concern for the environment, to include wetland habitats such as ponds, lakes, sewage lagoons, and rainwater drainage channels, has led many to believe that aquatic vegetation should not be controlled.
- Depending on your situation, some aquatic vegetation may be highly desirable and may serve to enhance the aquatic ecosystem. In other situations, it poses as a nuisance and potential safety hazard. Your main focus is to maintain aquatic ecosystems functioning for their intended purpose. Part of your responsibility is to control aquatic vegetative weeds as the situation dictates.

Slide 2.3 – Aquatic Weed Pests

- Characteristics
 - Aquatic plants are becoming a major problem within the United States. Almost everyone becomes concerned with aquatic plants at one time or another because each body of water from roadside ditches to the largest lakes supports aquatic vegetation. Controlling these plants is essential in all aspects of water use, including irrigation, drainage, animal consumption, recreation, pollution, and public health.
- Growth Characteristics
 - As the term implies, aquatic plants are plants that grow in or near water. These same plants become recognized as aquatic weeds when they interfere with the intended use of a water area where they are located. Aquatic plants are generally classified into three groups—floating, submersed, and emersed.
- Floating Plants
 - Floating plants are plants that germinate in the bottom of a body of water at first and, soon after germinating, become separated from the soil, and float on the surface of the water. Once they are separated from the soil, they no longer depend on the soil—duckweed and water hyacinth are examples.
- Submersed Plants
 - Submersed plants are aquatic plants that complete their entire life cycle below the water surface; however, some of these plants may have floral parts that extend above the water surface. Most of these plants are rooted, but some, such as algae, are not rooted. Brazilian elodea, broadleaf watermilfoil, coontail, naiad, and widgeongrass are examples of common rooted submersed aquatic plants.
- Emersed Plants
 - Emersed plants are plants that are firmly rooted to the soil in close proximity to water. During normal growth, these plants extend above the water surface. American lotus, arrowhead, cattail, foxtail, pondweed, softstem bulrush, and willows are common examples of emersed aquatic plants.

Slide 3.1 – Identification Intro

Slide 3.2 – Identification

- As with other pests, the key to controlling pests is to correctly identify them. Likewise, with aquatic weed pests, you must first identify the weed pest and then take steps to implement control operations. At first, the task of identifying your aquatic weed pests may be a little time consuming, but in the long run it pays off.
- To some people, a weed is just a weed; to an integrated pest management (IPM) minded pest management journeyman, the challenge is to know the pests you are dealing with prior to just spraying pesticides to control them. This lesson addresses the most common floating, submersed, and emersed aquatic weed pests.

Slide 4.1 – Pros and Cons Intro

Slide 4.2 – Pros and Cons

- The Federal Insecticide, Fungicide, and Rodenticide Act or better known as FIFRA, is the federal law that regulates the production, transportation, sale, use, and disposal of

Slide 4.3 – Identification Menu

- Floating
- Submersed
- Emerged
- Herbaceous

Slide 4.4 – Floating

Two of the most common floating aquatic weed pests you will encounter in your Air Force career include: duckweed and water hyacinth.

- DUCKWEED
 - Duckweed (*Lemna minor*) is a very minute free-floating, seed-bearing plant that grows in slow-moving fresh water—ponds, lakes, and storm water retention areas. They are extremely prolific plants and can rapidly expand to cover the entire surface of the freshwater site they are invading
 - Increased nutrient levels (manure and fertilizers) in the water favor the rapid growth. It has one to three leaves approximately 1/16 to 1/8 inches in length. The plant has a single root that extends from each leaf. They tend to grow in dense colonies in still water that is undisturbed by wave action.
 - Duckweeds can be aggressive invaders and if colonies cover the entire water surface the results are severe oxygen depletion and fish kills. Duckweed is readily eaten by many ducks and is inadvertently transported from one body of water to another by them.
- WATER HYACINTH
 - Water hyacinth (*Eichhorea crassipes*) is endemic to South America but has colonized much of the Southern US waterways, especially Florida and Louisiana. This free-floating perennial plant can grow up to 3 feet in height. It has dark green circular to elliptical shaped leaf blades that are attached to a spongy, inflated petiole.
 - The plant's dense, heavily branched, dark fibrous root system extends below the water surface. Part of the plant's attractive qualities is its prominent light blue to violet flowers that extend above the plant's dense foliage on a terminal spike. Like duckweed, water hyacinth is a very aggressive invader of freshwater sites and can form thick mats that cover the entire water surface.
 - Additionally, if colonies cover the entire water surface, severe oxygen depletions and fish kills are likely to occur. People primarily transport water hyacinths from site to site for their showy flowers. Some states have strict restrictions on their transport and even consider their possession as illegal.

Slide 4.5 – Submersed

- This section addresses the most common submersed aquatic weed pests. Although algae are not a true weed pest, they are included here because they more closely display the characteristics of submersed aquatic weed pests.
- ALGAE
 - Algae are very primitive plants. A few are microscopic (planktonic—*Chlamydomonas*, *Chlorella*, *Euglena*, *Closterium*, *Anacystis* spp., etc.) while

others may form stringy or hair-like structures (filamentous—Spirogyra, Anabaena, Oscillatoria, Lyngbya, Pithophora spp., etc.). Some are large enough to resemble other plants (chara—Chara spp.) A key characteristic of chara is that it lacks true roots.

- The primary problems associated with algal growths is that they block waterways, irrigation systems, storm water drains, and deplete oxygen levels resulting in fish kills. Waters high in artificial nutrients (animal feces, fertilizer runoff, snow removal chemicals - such as urea) generate the densest algal blooms.
- **BRAZILIAN ELODEA**
 - This Brazilian native is an introduced species. Brazilian elodea (*Egeria densa*) is commonly used as an aquarium plant but quickly invades ponds and lakes due to inadvertent introduction. It looks similar to its native relative *Elodea canadensis* (waterweed) but is definitely more robust in shape. It is a multi-stemmed, rooted perennial plant that may survive and grow as floating fragments.
 - It has bright green blade-like leaves that are 1 to 3 centimeters (cm) long and 5 millimeters (mm) wide. The leaves spiral around a central stem in sets of four. The upper portion of the leaf has four to eight sets of leaf whorls. It grows in either still or slow-moving waters such as pools, ponds, lakes, ditches, and streams. The roots of this plant may extend up to 20 feet in depth. In the United States (US), this plant reproduces through fragmentation.
 - Brazilian elodea forms dense mats that clog up existing waterways and is quite often confused with Hydrilla and *Elodea canadensis*. The difference between these plants is the number of leaves per whorl. Brazilian elodea has four, Hydrilla has a set of five, and *Elodea canadensis* has a set of three leaves. Some states restrict the sale of this plant; others consider it illegal.
- **BROADLEAF WATERMILFOIL**
 - This perennial aquatic plant favors ponds, ditches, and slow-moving streams. Broadleaf watermilfoil (*Myriophyllum heterophyllum*) is primarily a submerged plant but may occasionally produce emergent leaves that grow up to 3/4 inches in length.
 - It flowers between April and late July. The top portion of the flower stalk is stem-like and produces small serrated leaves or bracts that are longer than the flowers. Some states consider this plant as a special concern because of its limited distribution due to habitat loss, invasive aquatic plants, and overall declining population.
- **COONTAIL**
 - Coontail (*Ceratophyllum demersum*) is a dark olive green perennial submerged plant that has no roots. It has ridged leaf spirals and small tooth-like projections along the leaf edges. The branch tips are covered with leaves giving them a raccoon tail shape, hence the name —coontail. This plant reproduces both through seeds and fragmentation
- **NAIAD**

- Naiad (*Najas* spp.) is a submersed plant that has brittle stems. The stems grow up to 20 inches long and are often branched toward the top of the plant. The stem internodes usually have prominent, brownish, spiny teeth. The leaves grow opposite to each other and in whorl sets of three, 0.5 to 4.0 cm long, and have triangular teeth along the leaf margins in addition to spines along the midrib on the leaf undersides.
- The flowers grow single leaf stems. Naiad favors brackish or highly alkaline ponds, lakes, and coastal and inland marshes. They reproduce by seed and fragmentation. The primary problem associated with naiad is that it interferes with boating activities along major waterways. Ducks forage on this weed pest and play a major factor in its long-range dispersal.
- WIDGEONGRASS
 - Widgeongrass (*Ruppia maritima*) is a completely submerged perennial aquatic weed pest and has single and/or multi-branched stems. Stems can reach lengths up to 3 feet. Leaves alternate from one side of the stem to the other and are narrow, resembling thread up to 4 inches long.
 - Its flowers and fruit structures cluster together near the tip of the stems. Widgeongrass has small dark-green, pear-shaped fruits. Widgeongrass can thrive in both fresh and brackish waters. When the stems break off in the current, the floating stems can clog up irrigation channels and interfere with equipment.

Slide 4.6 – Emerged

- Of all the aquatic weed pests, emerged plants are the ones we have easiest access to. They stick out of the water having exposed foliage. Some of these weed pests are somewhat herbaceous and have woody stems while others do not. The majority have their roots extending well below the water surface while their leaves project above the water.
- The kinds of aquatic weed species you encounter depend on what installation you are located at around the globe. Some locations will have no aquatic pests whatsoever. Knowing what weed pest you are dealing with requires correct identification. Some weed pests look quite similar to each other. Let us start with one of America's most common emerged aquatic flowering plants—American lotus.
- AMERICAN LOTUS
 - This perennial aquatic plant is commonly confused with water lilies. American lotus (*Nelumbo lutea*) has circular, simple leaves attached in the middle to the end of long stalks that are bluish-green in color. Some American lotus leaves measure up to 2-feet in diameter. The key difference in the leaves between American lotus and water lilies is that American lotus leaves do not have the characteristic split leaves. Typically, the leaves are flat and float above the water surface.
 - At times the leaves may project above the water surface and form somewhat of a cone shape. The flowers are quite large and yellowish-white averaging no more than 20 petals. The seed structure looks like an inverted shower head which points up. The seedhead has a circular opening from which the seeds disperse

once developed. American lotus is capable of spreading by seed production and rhizomes. American lotus is capable of forming extremely dense colonies that can totally obstruct open waterways.

- **ARROWHEAD**

- Throughout the world there are many species of Arrowhead (*Sagittaria* spp.) This perennial weed pest is equipped with arrowhead shaped leaves. The leaves typically have three points giving it the arrowhead shape. Some arrowhead plants have extremely narrow grass-like leaves. They prefer shallow waters and areas that remain constantly wet.
- The leaves spread out from a central base and fan out in clusters and grow from a few inches in size to up to 4 feet. Arrowheads have widespread rhizomes; a few species have large well-developed tubers. Their flowers are produced on separate stems (stalks) well above the water surface and have three whitish-pink petals. The primary mode of dispersal is through seeds and widespread rhizomes.

- **CATTAIL**

- These plants have long round tipped leaves that can grow between 5 to 10 feet in height. The leaves typically have a slight twist from the base to the tip of the leaf. Cattail (*Typha* spp.) flowers consist of a thick, dark brown, cigar-shaped spike (catkin). Depending on the location, cattail plants may be partially submerged based on seasonal floods but do not normally infest open waterways. They typically line the fringe of most waterways.
- They are capable of spreading very quickly by both seeds and rhizomes. When mature, the catkins form a fluffy down material that is carried by the wind or water to other favorable rooting areas. Cattails can quickly overtake shallow ponds and make them impassable. Eventually, over the course of several years, sediment buildup causes the pond, lake, or wetland areas to fill.

- **FOXTAIL**

- There are several species of foxtail (*Setaria* spp.) Foxtail is an annual grass that forms dense, cylinder-shaped seed heads that somewhat resemble a fox's tail, hence the name foxtail. This weed pest is typically found along the margins of aquatic areas such as marshes and wetlands. Foxtail does not spread by rhizome action.
- Its primary dispersal method is through abundant seed production. This weed pest has upright leaf stems with stems ending in a seed head well above the plant's base root structure. The stems can reach up to 3-feet in height while the leaves are approximately 12 inches long. The seed heads are covered with fine hairs that turn yellowish when fully mature.

- **PONDWEED**

- Pondweeds (*Potamogeton* spp.) include a vast group of rooted aquatic weed pests that have totally or partially submerged floating leaves. All pondweeds have alternating leaves. The flowers that mature into seed heads are above the water surface on a spike. Their stems or stalks vary in length from a few inches to several feet. Some pondweeds have both floating leaves and ribbon-like

submerged leaves. Some of the leaves appear to be thread-like while others may be broad—oval or lance-shaped. Once established, pondweeds form dense matted colonies which impede water navigation and water flow.

- **SOFTSTEM BULRUSH**

- Softstem bulrush (*Scirpus validus*) resembles a dense colony of stalks growing in the water and terminating in small flowers. The stalks can grow up to 8 feet high and are somewhat round, triangular, light green, smooth, spongy and about 1 inch wide towards the base. The stalks taper towards the tip and end with a flower head containing hanging clusters of spikelets (multiple small flowers). The spikelets are blunt, brown, and contain as many as 50 flowers that form nutlets when mature. Each nutlet is equipped with barbed bristles. Softstem bulrush is a food source for many native birds.

Slide 4.7 – Herbaceous

- **COTTONWOODS**

- Cottonwoods (*Populus* spp.) belong to the Poplar family and prefer to grow along the banks of riparian corridors, such as the fringes of wetlands, ponds, lakes, ditches, rivers, and streams. In areas where their growth is inhibited, they grow to the size of small bushes. Areas that tend to favor a cottonwood's growth may produce trees that reach an excess of 150 feet tall.
- The foliage of this weed pest consists of broad triangular-shaped, toothed leaves that are bright green when new and turn darker green as the foliage matures. Cottonwoods are a deciduous tree (lose their leaves in the fall). The leaves are typically attached to a stem by a 1- to 2-inch stalk and alternate from one side to the other. They are a fast-growing tree that can crowd out other species. They quickly spread around existing waterways by method of their seed dispersal.
- When mature, the tree produces seed pods that open towards the latter part of summer. Seed dispersal is accomplished by the wind and water. Fluffy white down surrounds individual seeds and aids in maintaining them aloft as they float from place to place. Prevent this type of tree from growing at dams, pond levees, sewer lagoons, and other similar water holding reservoirs. Cottonwood roots can easily penetrate dam support structures and cause them to leak.
- NOTE: Cottonwoods are the state tree for both Kansas (*Populus deltoides*) and Wyoming (*Populus sargentii*). You will have to contact your local county extension agency and/or Natural Resource Program Manager prior to implementing any type of cottonwood control in these states.

- **WILLOWS**

- Like cottonwoods, willows like to grow on the fringe of wetlands, ponds, lakes, ditches, rivers, and streams. Some willows (*Salix nigra*) grow to the size of small bushes while others may grow in excess of 70 feet tall. The foliage of this weed pest consists of lance-shaped, simple leaves that are bright green

on top and have pale green undersides. The leaves are attached to a stem by a short stalk and alternate from one side to the other.

- Willows are very aggressive and can quickly spread around existing waterways and may thoroughly overtake some if drought conditions prevail. Like cottonwoods, try to keep this type of tree away from dams, pond levees, sewer lagoons, and other similar water holding reservoirs. Willow roots can also easily penetrate dam support structures and cause them to leak.

Slide 5.1 – Contingency Weed Control Operations Intro

Slide 5.2 – Contingency Weed Control Operations

- Like terrestrial weed controls, aquatic weed controls usually have a low priority during contingency operations. Use situational awareness to determine whether you will have to implement aquatic weed control operations. Disease vector controls are usually your utmost priority during contingencies. In order to accomplish disease vector controls, you must eliminate all possible harborage sites.
- This involves using IPM techniques to minimize aquatic weeds during your control operations. Currently, most of our contingency operations involve working in extremely arid environments. Future contingency operations may take you to just about any part of the world. Your responsibility is to manage the elimination of unwanted weed pests. The determining factor used to control aquatic weed pests is based on situational awareness.
- If the local situation dictates, you may be required to treat aquatic weed pests in areas where their presence poses a security threat, such as along fence lines, near weapon storage areas, and areas in close proximity to military quarters. Because aquatic weed pests can conceal or provide cover to the enemy, you may be tasked to eliminate them. Assess your risks and implement the necessary corrective actions based on your particular location or given situation.

Slide 6.1 – Surveillance and Controls Intro

Slide 6.2 – Introduction

- As pest management journeymen, you will be dealing with weeds particularly of the vegetative type. Your responsibility involves surveying and managing aquatic weeds. Remember, you cannot manage or control that which you know nothing about. Take time to further study and conduct thorough research of the pests you are dealing with prior to employing your IPM techniques weapons arsenal.

Slide 7.1 – Surveillance Intro

Slide 7.2 – Surveillance

- The vast majority of the plants described in the previous section were invasive aquatic weed pests. You may ask yourself: 'What is an invasive weed?' Simply put, an invasive weed pest is a plant that interferes with, or has the potential to interfere with, the value or use of a waterway.
- Part of your responsibility is to coordinate with your local, state, and other federal authorities to prevent the introduction of aquatic weed pests. Familiarize yourself with each agency's requirements and implement them. Exercise caution when transporting

cargo so that you do not inadvertently transport and introduce undesirable aquatic plants. Once you have your requirements laid out, implement a surveillance program to monitor your aquatic environments. Start with an ecosystem and water body assessment.

Slide 8.1 – Ecosystem Assessment Intro

Slide 8.2 – Ecosystem Assessment

- An ecosystem assessment involves the use of multiple survey tools to collect data relevant to assessing the biodiversity of an area—pond, stream, lake, river, ditch, storm water catch basin, and so forth. You use the collected data to determine the level of control required to suppress a species; yet not hinder or eliminate a non-target organism. This process is quite similar to conducting a baseline survey. The difference is that you are focusing on the aquatic habitat.
- Focus the assessment on the availability and population levels of invertebrates, vertebrates, and vegetative organisms. The purpose of this assessment is for you to gauge the impact of any corrective measures you implement. Aquatic organisms depend on the vegetation growing in and around water bodies for oxygen, food, and shelter. Indiscriminate aquatic vegetation control treatments can have a severe impact on oxygen levels and the availability of food and shelter.
- INVERTEBRATES
 - Aquatic invertebrates are the food sources for many other higher forms of life. They form a vital link in an aquatic ecosystem's biodiversity. Document the presence of all invertebrates in the water bodies requiring control—this should be a baseline survey of all aquatic invertebrates present. Later, you can use the information you collect to determine the impact of the IPM control techniques used.
- VERTEBRATES
 - As with aquatic invertebrates, vertebrate animals rely on the presence and availability of aquatic invertebrates as a food source. For example, freshwater shellfish serve as a food source for raccoons and fish. Others, such as ducks, geese, deer, and moose, use the aquatic environment as a source of water, food, and shelter. Document the presence of all vertebrates using the water source.
- VEGETATIVE
 - Game birds, aquatic invertebrates, and vertebrates use aquatic vegetation as a source of food. Document the presence of desirable and non-desirable plant species. Use the documentation to focus your control efforts on controlling non-desirable vegetation.

Slide 9.1 – Water Body Assessment Intro

Slide 9.2 – Water Body Assessment

- The purpose of a water body assessment is to help you select and apply the most efficient, effective, and economical IPM technique. Include an assessment of the water body's use, physical condition and limitations, chemistry, and volume during droughts or periods of heavy rains.
- USAGE

- For the majority of the water bodies on your installation, you already may know their particular use, but for others you may have to do a little research. Consult with the Natural Resources Program Manager for those areas you are not familiar with. Investigate where the water drains off to. Is there a farmer's field that receives water from your storm water catch basins?
- Is the water used for drinking purposes? Does it drain to a protected wetland, pond, lake, stream, river, and so forth? What recreational purposes does the water body serve—swimming, fishing, livestock watering, or commercial fishery? Answer these questions and others you can think of prior to establishing a control program.
- PHYSICAL CONDITIONS AND LIMITATIONS
 - In some locations you may have so many aquatic weed pests present that you may not be able to access all areas that require control. Annotate all physical conditions and possible limitations. During certain times of the year, heavy rainfall may prevent access—document drought periods, periods of heavy rain, and so forth.
 - Some water bodies have running water. Others may contain standing water catch basins. Water flow also plays a significant impact on your control efforts. Too much water flow decreases the likelihood of establishing good control and may require you to implement additional controls.
- CHEMISTRY
 - Have the water body tested for its chemical constituents. Do you have hard water or soft water? You are probably wondering what hard and soft water is. Simply put, it refers to the level of minerals present in the water, particularly calcium and magnesium levels. Is your water alkaline or acidic? Some chemical controls will not be as effective depending on your water's chemical make-up.
 - For example, some aquatic herbicides contain copper—in soft water the effects may intensify and the result is a fish kill. Another example is the presence of high levels of nitrates from storm water runoff that may have a direct impact on the level of algal growth. The key thing is to get the facts straight prior to implementing any type of controls.
- VOLUMES
 - Determine the size of your water bodies. Since most of our IPM controls involve using acre/feet as a unit of measurement, you need to know how much of an area requires treatment. Consult with your drafting and engineering section in the civil engineer squadron for accurate water body measurements. Conduct a yearly visual inspection during the summer months to ensure aquatic vegetation is not causing an encroachment problem in your installation's waterways or water bodies.
 - This includes surveying all ditches, holding tanks, ponds, or lakes. If you have a particular aquatic pest weed species that you consider as undesirable within a given waterway, implement appropriate weed control measures where and when appropriate. Weeds growing in waterways promote erosion by causing the

water to change its course (flow around them). These weed pests require control to ease water flow conditions during periods of heavy rains.

Slide 10.1 – Controls Intro

Slide 10.2 – Controls: Introduction

- All pesticidal treatments, if any, of established waterways and/or wetland designated locations must take into account the area's primary use, such as storm water runoff collection, wildlife habitat, or recreational-type activities. Treatment timing is also vital to ensure minimum impact on sensitive non-target organisms, such as aquatic invertebrates and other wetland vertebrates
- Implement IPM strategies to determine the most practical way to accomplish and/or treat the weed pest to include mechanical removal methods. Prior to treating waterways or wetland environments, coordinate all your pesticidal treatments through your installation's Natural Resources Program Manager to determine acceptable injury level or action thresholds. You have a diversity of IPM controls at your disposal.
- Determine which are more appropriate for your area and implement them. Some IPM methods include both preventive measures—water body location and construction, fertilization, and water body drawdown, and corrective measures—mechanical, biological, and chemical. Each IPM method has its advantages and disadvantages.
- Use the most appropriate IPM methods for your given situation and use chemical controls only as a last resort. It is easier to prevent a problem than to correct it. Determine what works for your area and use it. Like the old cliché goes, "An ounce of prevention is worth a pound of cure." Likewise, if you implement proper preventive measures, your need to use chemical control measures is reduced.

Slide 10.3 – Identification of Wartime Facility Damage

- Preventative Measures
 - Proper implementation of water body location and construction, fertilization, and water body drawdown preventive measures will cut down on the need to use herbicide.
 - WATER BODY LOCATION
 - Prior to establishing a new water body, whether it is a pond or storm water catch basin, carefully select the area best suited for its location. Try to limit its location where excessive water flow will hinder the establishment of a stable aquatic environment. Base your location on land use, vegetative plantings, soil type, and the slope of the land.
 - Avoid locating a water body where excessive water flow from nutrient-rich water sources exists—such as septic system runoff, heavily fertilized fields, and organic nutrient sources (cow manure). Excessive nutrients increase weed growth and algal bloom formations. Create a diversionary ditch to divert excessive water flow in a controlled manner.
 - WATER BODY CONSTRUCTION
 - Algae, submersed, and emersed rooted aquatic weeds usually start growing in shallow water that is 2 feet deep or less. Once established, they will often extend into deeper water areas. When practical, you may

have to coordinate the deepening of existing water bodies to discourage weed and algal growths. Construct water bodies so that there is little if any water depth less than 2 feet deep.

- FERTILIZATION
 - Not all algae are detrimental. At times, you may want to encourage good algal growth to suppress the growth of undesirable vegetation. Plan your fertilization effort during the fall and winter months after undesirable vegetation has died back. An early spring herbicidal treatment followed by the application of fertilizer will promote growth of beneficial algae.
 - NOTE: Consult with your local extension agency, Natural Resource Program Manager, US Fish and Wildlife service representative prior to implementing a fertilization application. After all, you do not want to promote the growth of undesirable vegetation and increase your problems.
- WATER BODY DRAWDOWN
 - Another preventive option includes allowing your water body to drawdown during the winter. Some areas actually go almost completely dry during the winter months. This allows sufficient time for the vegetation to die off during the winter for easy removal. In areas where the winter is very mild, this may not be an effective preventive control.
- Corrective Measures
 - When preventive controls are not getting the job done, you may have to implement corrective controls. These include the use of mechanical, biological, and herbicidal controls. Use the IPM method that is most appropriate for your area, but limit your chemical applications.
 - MECHANICAL CONTROLS
 - The control of aquatic plants is based on the type and location of the plants being controlled. Controlling aquatic plants presents many problems for you because control often affects other aquatic life. Mechanical control methods for aquatic plants include burning, chaining, covering, dredging, drying, mowing, and pulling or raking.
 - BURNING
 - Burning is an effective mechanical control measure for controlling young succulent plants along canals and drainage ditches. Burning is most generally done by searing the plants first, then finishing the burn a week or two later.
 - CHAINING
 - Remove aquatic plants from canals and drainage systems by dragging a heavy chain between two tractors on opposite banks. Tow the chain in one direction and then back in the opposite direction to be most effective. Dragging the chain through the water will detach rooted submersed plants and emerged plants from the bottom of the body of water. Once these plants have been detached from the bottom, remove them from the water by raking.

- COVERING
 - For small water bodies requiring total vegetation controls, consider using a black plastic sheeting to cover the entire water body. The restricted access to sunlight normally kills all vegetation under the plastic sheeting. Leave the plastic in place for a period of 2 weeks to attain temporary vegetation control.
- DREDGING
 - Dredging seems to be equally effective for all types of aquatic vegetation, but use it with caution. Equipment used for dredging should be equipped with weeding forks instead of the normal bucket.
 - Although dredging operations are very effective for removing aquatic vegetation, they are not very advantageous in other aspects. Removing vegetation by dredging also removes mud along with the weeds, therefore enlarging and deepening the water holding area, causing a change in capacity.
 - Although dredging operations are very effective for removing aquatic vegetation, they are not very advantageous in other aspects. Removing vegetation by dredging also removes mud along with the weeds, therefore enlarging and deepening the water holding area, causing a change in capacity.
- DRYING
 - Drying may effectively control submersed aquatic weeds, especially those in hot, arid regions. This method is often objectionable because it requires complete drainage of the area, which, in most instances, must be done when the water is needed the most.
- MOWING
 - Use mowing to control aquatic vegetation growing along the sides of canals and drainage systems provided banks are smooth enough, not too steep, and relatively unobstructed. Use specially designed power-driven weed saws and weed cutters to control rooted submersed plants and emersed plants within bodies of water.
- PULLING OR RAKING
 - Rid small water bodies of aquatic plants by hand pulling or raking the plants from the water.
- Biological Controls
 - Biological controls include the use of a living organism, such as fish, insects, and bacteria to control undesirable vegetation. Certain fish and snail feed on many aquatic weeds and, at times, they will virtually eliminate aquatic weeds in ponds and lakes. Carp and sunfish are very important in reducing aquatic vegetation, and the Marisa cornuarietis snail has shown promise in controlling aquatic weeds in Florida.
 - NOTE: Consult with your local extension agency, Natural Resource Program Manager, US Fish and Wildlife service representative prior to implementing a

biological control. Some states prohibit the introduction of fish to control aquatic vegetation.

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- Herbicidal Controls Overview
 - The great majority of aquatic herbicides are relatively safe and effective when you select and apply them in accordance with label directions. Familiarize yourself with the herbicide label. Always adhere to all warnings and precautions concerning its use.
 - You can cause severe damage to an ecosystem if you misapply aquatic herbicides. For example, using too much herbicide at one time may cause oxygen depletion and result in fish kills. Always thoroughly read and understand the herbicide label prior to purchasing and applying the product.
 - NOTE: Consult with your local county extension agent, Natural Resource Program Manager, and the US Fish and Wildlife service representative for advice concerning aquatic herbicide selection, methods, and rates of application, precautions, and other state and federal regulations. An example of a federal regulation is the Clean Water Act of 1977, which establishes the basic structure for regulating discharges of pollutants into the waters of the US.
- Herbicidal Controls Selection
 - Prior to choosing herbicidal products, ensure you correctly identify the weed, find the water body volume (surface area and depth), and determine water body uses. This will help you select the most effective, least toxic, and economical aquatic herbicide available.
 - WEED IDENTIFICATION
 - A single aquatic herbicide is not capable of controlling all of the weed pests that pose as a potential concern. Therefore, is very important for you to properly identify the aquatic weed pests before you attempt to control them.
 - WATER BODY VOLUME, SURFACE AREA, AND DEPTH
 - Determine herbicide application rates by either using prior knowledge of the water body's volume or multiplying the surface area by the depth to determine acre/feet. Some herbicide application rates will vary depending upon the weed species and the extent of infestation. Prior knowledge of the pond's water volume and surface area will aid in the selection of the least toxic and most economical herbicide.
 - WATER BODY USE
 - Herbicidal product restrictions and precautions vary greatly depending on the herbicide. Familiarize yourself and adhere to the restrictions and precautions on the product label. If water body uses are not compatible with the restrictions and precautions listed on the herbicide product label, select an alternate herbicide or another IPM aquatic weed control measure.
- Herbicidal Controls Application

- So, you have chosen the herbicide that is least toxic and most economical for the aquatic herbiciding job. Is this enough? Have you exhausted all other options? Not quite! It is not enough to select the right herbicide. You must also apply the herbicide properly to achieve the desired management level.
- As a Pest Management Journeyman, you must be knowledgeable enough to recognize the herbicide formulations, methods, and rates of application; precautions and warnings; and other information specific to the herbicide you are going to use.
- FORMULATION
 - Herbicide formulations vary in the amount of active ingredients present. The active ingredients actually are the chemicals that kill the pest or weed. Inert ingredients are added to improve the convenience, safety, and handling of the herbicide. Herbicide application rates are based upon the active ingredient in the herbicide formulation. This is one reason why it is always important to determine herbicide application rates from information printed on the label.
- METHODS
 - You may apply certain herbicides directly from the container (ready-to-use—RTU). Others require special preparation and mixing before application. Always follow label directions. How you disperse the herbicidal product is also important. In small water bodies, you may only need to conduct a spot treatment while others may require a broadcast application over the entire area. You can scatter granular formulations directly over an area.
- METHODS
 - When treating a small area, consider using a sprinkling can; large areas, on the other hand, usually require the use of hydraulic sprayer or granular spreader. At times, applying the herbicide from the shoreline is not practical. You may have to obtain a boat with an outboard motor to ensure the proper and even herbicide dispersal.
 - You may apply most aquatic herbicides with a hand-operated granular spreader, compressed air sprayer, or a boat bailer (handheld cup or jug). If you inject the herbicide near the outboard motor prop-wash, you will obtain a better dispersal of the product. Consider that some herbicides are contact killers and need to be sprayed directly onto the foliage (leaves) to be effective.
 - Therefore, evenly disperse contact herbicides in or on the water to obtain the best results. Translocated herbicides are also quite effective because they are absorbed by the plant's foliage and transported down to the root resulting in a complete kill. Use this chart as general guidelines when applying aquatic herbicides to control algae, floating weeds, submersed weeds, and emersed weeds
- APPLICATION RATES AND TIMING

- If you have to treat an aquatic weed pest with herbicidal products, it is best if you apply them in the spring or early summer. This is when the weeds are starting or actively going through their annual growth cycle. Apply aquatic herbicides when the water temperatures are above 55° F and/or when aquatic weed pests start showing signs of new growth.
- The following are some advantages of spring or early summer treatments:
 - Reduces chance of fish kills due to oxygen depletion
 - Reduces use of herbicides due to aquatic weed pests being underdeveloped
 - Increases effectiveness of herbicidal products on earlier aquatic weed pest growth stages
 - The total aquatic weed pest mass is less, so less herbicide is required for adequate coverage
 - Reduces liability from possible contamination of downstream water sources
- NOTE: Do not second guess yourself when conducting aquatic weed pest management operations. Always adhere to the label recommendations. In large water bodies, it is best to only treat smaller sections. Wait 2–3 weeks between applications. During the warm summer months, never treat the entire pond with an herbicide at one time, no matter how minor the weed infestation.
- Dead and decaying plants consume oxygen from the water. Treating a small portion of the water body allows fish and other aquatic inhabitants time to swim out to oxygenated waters while the weeds are decaying. Thus, you reduce the likelihood of a fish kill. Do not wait until the water body is completely clogged with aquatic weeds. Use common sense and spot treat the area before the weeds become a problem
- PRECAUTIONS AND WARNINGS
 - Follow the specific instructions listed in the precautions and warnings on the herbicide product label. Limit any possible personal health and environmental hazards resulting from their proper use by adhering to them. Implement aquatic chemical controls only as a last resort. Always use the least toxic and least amount of aquatic herbicide required to establish aquatic weed controls.

Slide 11.1 – Course Completion

Congratulations, you have completed the identify, survey & control measures for weeds part 2 of 2 lesson. Please click complete lesson to receive credit.

3E453 – Pest Management Journeyman

Module 3, Lesson 2 Task 1 (10.9.1, 10.9.3, 10.9.4) Household and Nuisance Pests

Slide 1.1 – Introductory Slide

Slide 1.2 – Lesson Title Slide

3E4X3 Career Development Course

10.9.1, 10.9.3, 10.9.4 Household and Nuisance Pests

Slide 1.3 – Instructions

Welcome to the Identify, Survey and Control Measures for Household & Nuisance Pests lesson.

- Upon completion of this lesson, you must be able to identify basic facts and principles relating to identify, survey and control measures for household and nuisance pests with at least 75% accuracy.

Overview

In this section, we will cover the following topics:

- Household & Nuisance Pests Identification
- Household & Nuisance Pests Survey
- Household & Nuisance Pests Control

Slide 2.1 – Household & Nuisance Pests Identification Intro

Slide 2.2 – Identification Menu

- Identification Overview
- Cockroach Identification
- Ant Identification
- Other Nuisance Pest Identification

Slide 2.3 – Identification Overview Video

- Video Closed Captions

Household and nuisance pests are potentially a pest manager's most difficult task because of the time and special knowledge it often requires. This unit deals with pests that are problems at military installations worldwide. Cockroaches, ants, stored-product pests, fiber and fabric pests and miscellaneous pests are all considered common household and nuisance pests. It may be unlikely that all species of ants, flies, cock roaches and wood destroying insects are present in a given region or area. With that being said, it is expected of you as a pest manager to know those pests beyond your personal experiences. By the end of this course, you should have a very good

understanding of what each type of insect looks like and how to recognize the different species of pest. Studying and understanding the common pests in your local area is extremely important and knowing other types of insect.

Slide 2.4 – Key Takeaways: Identification Overview

- Cockroaches, ants, stored-product pests, fiber and fabric pests and miscellaneous pests are considered common household and nuisance pests.
- Studying and understanding the common pests in your local area, as well as knowing other types of insects, is extremely important.

Slide 2.5 – Cockroach Identification Menu

- Cockroach Identification
- Cockroach Biology
- Cockroach Species

Slide 2.6 – Cockroach Identification Vid

- Video Closed Captions

Cockroaches form part of the Order Dictyoptera and the Family Blattidae. They are among the world's most common and cosmopolitan insects. There are about 3,500 known species - with some 55 species residing in the US. Cockroaches are important primarily because of the cost of managing them in all types of structures including ships and aircraft. No other group of pests requires as many work hours of effort or more of the pest management budget. In recent years, as much as 50 percent of the budget for pest management services provided by Civil Engineer Pest Management personnel has been devoted to cockroach management on military installations. Although cockroaches have never been identified as disease vectors in epidemics, their close association with people and food supplies necessitates effective management. Their habits, body structure, and mobility certainly make them well-adapted to mechanically transmit diseases.

Slide 2.7 – Key Takeaways: Cockroach Identification

Cockroaches form part of the order Dictyoptera and the family Blattidae. They are among the world's most common and cosmopolitan insects.

There are about 3,500 known species—with some 55 species residing in the United States (US).

Although cockroaches have never been identified as disease vectors in epidemics, their close association with people and food supplies necessitates effective management.

Slide 2.8 – Cockroach Biology

- Biology Part 1
 - Cockroaches undergo gradual metamorphosis with three stages.
 - Egg
 - Nymph
 - Adult
 - Immature nymphal cockroaches generally eat the same food as adults and resemble the adult life stage. They are considered omnivores, (they eat both meat and plants) and are especially fond of starchy materials such as cereals, sweetened or sugary substances, and meat products.

- Cockroach eggs are deposited in a purse-like sac or egg case called an ootheca
- Ootheca's will vary in size and shape dependent on the type of cockroach species
- All fertile eggs in the ootheca hatch at the same time in order to break through and escape the capsule
- Biology Part 2
 - Nymphs resemble adults, but are smaller and lack functional wings
 - As the nymphs grow, they molt several times; after the last molt the wings are fully formed and the cockroaches are sexually mature
 - Adult cockroaches may have long, functional wings, or they may have short or rudimentary wings, depending on the species
 - In some species, males are winged but females have only rudimentary wings
 - Most cockroaches are nocturnal and secretive in habit, but others are active during the daytime, especially if large populations are present and food is scarce.
 - The principal reason for their success, however, is their highly adaptive nature, enabling them to exploit to changing environments.
 - Although cockroaches have never been identified as disease vectors in epidemics, their close association with people and food supplies necessitates effective management.
 - Their habits, body structure, and mobility certainly make them well-adapted to mechanically transmit diseases.
- Biology Part 3
 - Cause two main types of damage:
 - Aesthetic
 - Many people are repulsed or disgusted by the sight of cockroaches
 - Excrete a substance that causes stains on surfaces and leaves a
 - Medical
 - Cockroaches are known to carry human pathogens, such as Salmonella and E. coli, which can result in human diseases, such as food poisoning or diarrhea
 -
 - Debris created by cast-off cockroach skins, dead bodies and droppings can aggravate allergies, especially in children and sensitive individuals. musky odor
 - Medical
 - Cockroaches are known to carry human pathogens, such as Salmonella and E. coli, which can result in human diseases, such as food poisoning or diarrhea
 - Debris created by cast-off cockroach skins, dead bodies and droppings can aggravate allergies, especially in children and sensitive individuals.

Slide 2.9 – German Cockroach

- Characteristics
 - Each capsule contains 18 to 50 eggs that hatch in about 28 days

- At room temperature the average life cycle takes 60 days
 - Nymphs:
 - Resemble the adults except that they are wingless and darker in color.
 - Has a single stripe running down the middle of its back
 - Most common roach in houses in the U.S.
 - Adults:
 - Light brown and about 5/8" long
 - Both sexes have wings as long as the body but rarely fly
 - Two dark longitudinal stripes on the pronotum which resemble "Captain Bars"
 - Ootheca capsules are 1/3 of an inch long
 - Light-brown, yellow in color
 - Female will produce 4 to 8 egg capsules in a lifetime
- Habitat
 - Habitat/Habits:
 - Very active
 - Use items such as bagged potatoes and onions, bottle cases, cartons, and food packages as transports from place to place
 - They travel readily from one location to another, and, due to their small size, they can pass through very small openings.
 - The ideal German cockroach harborage is warm, dark, and moisture saturated and has small cracks and crevices or other small openings into dark confined areas.
- Key Importance
 - Has larger number of eggs per ootheca
 - Nymphs reach sexual maturity more quickly than other cockroaches
 - The females carry the egg capsules and protect the embryos until hatching
 - German cockroaches are small and conceal themselves
 - They can rapidly build up resistance to insecticides

Slide 2.10 – Brown-Banded Cockroach

- Characteristics
 - Rarely more than 1/2 inch long
 - Light brown and are easily distinguished from German cockroaches by two transverse (running from side to side) bands across the base of their wings and abdomen
 - Females are much broader bodied than the males
 - Both males and females are very active and the adult males fly readily when disturbed
 - Frequently found in the same building as German roaches
 - Females produce 14 capsules per lifetime each containing about 18 eggs
 - Attach egg capsules to an object for 24-36 hours before hatching
 - Depending on temperatures, eggs will hatch in 50 –75 days
 - Adults may live up to 10 months

- Nymphs and adults are generally found on ceilings, high on walls, behind picture frames, and near motors of refrigerators
- Habitat/Habits
 - The brown-banded cockroaches hide their ootheca around the kitchen sink, desks, tables, and other furniture.
 - This species is most active at temperatures above 80-degree Fahrenheit (°F); when the temperature falls below 75 °F, their activity decreases considerably.
 - They prefer high locations such as shelves in closets, behind pictures, and on picture moldings.

Slide 2.11 – Oriental Cockroach

- Characteristics
 - Brown to black in color
 - Females are about 1 to 1 1/2 inch long and the males are about 1 inch.
 - Female has small functionless rudimentary wings
 - The male wings cover about three - fourths of his abdomen
 - Neither the male nor the female will fly
 - The females are broader and heavier than the males.
 - The peak number of adults usually appear in late spring or early summer
 - Similar to American cockroaches, the oriental cockroach will carry their ootheca for about 30 hours before they drop or attach them, to a protective surface near a food supply
 - The average female will produce 8 capsules, each having 16 eggs that hatch in about 44 days
- Habitat/Habits
 - Oriental cockroaches can be found in homes in food packages, or merely come in under the door, or through air ducts or ventilators.
 - They are commonly found in sewers and utility closets and in dark, damp basements; and they are known to climb water pipes to upper floors in apartment houses.
 - This is a notably gregarious species (not naturally associating with other species), commonly found in large colonies

Slide 2.12 – American Cockroach

- Characteristics
 - Known as the "flying water bug"
 - Is the largest roach, reaching a length of 1½ inches or more
 - Reddish - brown, with a yellow border on the back of the pronotum
 - Both male and female are fully winged
 - Male's wings extend beyond the tip of the abdomen
 - Female's are the same length as the abdomen
 - Adults are capable of gliding (not flying) considerable distances if they take off from a tree or a roof top
 - Females form egg capsules at one per week until 15 to 90 have been produced
 - Each egg capsule contains 14 - 16 eggs

- Young nymphs are grayish brown and each will molt 9 to 13 times before reaching maturity
- Nymphs become more and more reddish - brown after first few molts
 - Nymphs and adults may be found in dark, moist areas, such as bathtubs, clothes hampers, and in sewers
 - Feeding on book bindings, clothing, and glossy paper with high starch content
- Habitat/Habits
 - American cockroaches prefer warm, moist habitats and are common in food-handling establishments and industrial plants.
 - Outdoors, they live under tree bark, in sewers, or in underground utility chases. This species may travel directly from the sewer to your home, carrying organisms on its body and legs that could contaminate your food and kitchen surfaces.
 - In southern states, it's also possible to find them living in palm trees.

Slide 2.13 – Australian Cockroach

- Similar to American - rarely more than 1 ¼ inch long
- Reddish-brown with a yellow margin on the thorax and a dark spot in the center of the pronotum
- Adult females drop their egg capsules shortly after they're formed, and the eggs hatch about 30 days later
 - There are about 24 eggs per capsule, but only 60 percent of this number usually hatches
 - A female will produce a new egg capsule about every 10 days
- Nymphs are brightly marked with distinct splotches of yellow on the dorsal side of the thorax and abdomen

Slide 2.14 – Ants Menu

- Ant Identification
- Ant Species

Slide 2.15 – Structure of Matter

- Characteristics
 - Ants are also widely known for their beneficial characteristics, such as aerating soil
 - Ants adversely affect people by:
 - Infesting our homes and other buildings, feeding on our food, or structurally damaging our buildings
 - They ruin the appearance of lawns, golf courses, and parks with their numerous and unsightly nests; they steal seeds from seed beds; and they defoliate or injure plants
 - They foster and spread other injurious insects such as aphids and mealy bugs
 - Ants can be especially annoying because of their bites and stings
- Biology
 - Ants have two distinct morphological characteristics that make them easy to identify.

- One of these characteristics is the separation of the abdomen into two distinct regions: (a) a slender one- or two-segmented, freely moving pedicel and (b) a large compact terminal portion called the gaster.
- Ants live in colonies with well- developed caste systems (specialized levels in a colony which carry out a specific function).
- Three distinct castes in ant colonies:
 - Workers
 - Sterile females
 - Size ranges from very small to almost as large as the queen
 - Larger workers are utilized as soldiers
 - They perform all of the work in the colony: nest building, nursing young, procuring food, and defending the colony
 - Queen
 - Largest individual in the colony
 - Those which have not mated retain their wings while the mated queens do not
 - Only function is to lay eggs
 - Male
 - Serve no function other than to fertilize the queen
 - After mating they die
- Life Cycle
 - Undergo Complete Metamorphosis: egg, larva, pupa, adult
 - Ant eggs are almost microscopic and (depending on the species) have various shapes
 - Upon hatching, soft legless larvae emerge
 - These larval forms are more or less translucent, gourd or squash shaped, and their heads are at the narrow end
 - Pupae resemble adults in form, but differ in that they are soft and unpigmented, and lack mobility
- Colony Development
 - Ants establish new colonies in a number of ways
 - The three most common ways are:
 - Splitting or Budding
 - A fertilized daughter of the queen leaves the parental nest, accompanied by a number of sister workers; these workers help establish and carry on the functions of the new colony
 - Parasitism
 - A fertilized female of one species adopts a colony of another species that doesn't have a queen
 - Chamber
 - A fertilized female constructs or enters into a preformed cavity in wood, the ground, or under the bark of a stump or log, closes the cell or cavity, and rears her first brood there

Slide 2.16 – Argentine Ants

- Characteristics
 - Workers are $\frac{3}{32}$ - $\frac{7}{64}$ (2.2 – 2.8 millimeters [mm]) of an inch long and light to dark brown
 - Queens are much larger $\frac{5}{32}$ - $\frac{15}{64}$ of an inch long
 - Nests are built in moist soil, next to structures and along sidewalks
- Habitat/Habits
 - Argentine ants prefer sweet foods and honey dew excreted from aphids
 - They tolerate humans and city environment and thrive in areas where other ants will not
 - They are very aggressive and will kill off other ant species nearby
 - Argentine ants do not sting but can bite
 - A single ant colony can contain millions of ants due to multiple queens existing within a single colony and many adjoining sub-colonies

Slide 2.17 – Pharaoh Ants

- Characteristics
 - $\frac{11}{16}$ - $\frac{5}{64}$ of an inch long
 - Color varies from yellow to brown
 - 3 segments in antennal club
- Habitat/Habits
 - Pharaoh ants feed on sweets, fatty foods, and get into everything
 - They are predaceous on many insects and have been found in hospitals where they feed on open wounds
 - Their nests are in undisturbed areas, usually adjacent to warm areas
 - They are very persistent and very difficult to control
 - They can have many females that are reproductive, and build new nests by budding
 - They do not sting

Slide 2.18 – Thief Ants

- One of the smallest ants in the U.S., being $\frac{3}{64}$ - 1 inch (1 - 1.5 mm) long
- Yellowish in color, sometimes confused with the Pharaoh ant
- Two segmented antennal club
- Often lives in the nest of larger ants feeding on the larvae of their host
- Rarely seen outdoors since they normally do not forage for food above ground
- Feed on a wide variety of plant and animal material

Slide 2.19 – Odorous House Ants

- Small- about $\frac{1}{8}$ th inch long
- Dark brown in color
- Name comes from the disagreeable odor similar to the smell of rotten coconuts that is given off when the worker ants are crushed

Slide 2.20 – Field Ants

- Length from $\frac{1}{8}$ - $\frac{9}{32}$ of an inch long

- Brown, black, red, or a combination of all three colors
- Prefers sweet foods and also will feed on other insects
- Most likely to be pests around recreational areas
- One species builds large mounds during nesting activities
- Seldom found indoors but has caused “fire ant” scares
- Some field ants capture the larvae and pupae of other ants and raise them in their own nests
- The emerging adults become slaves

Slide 2.21 – Crazy Ants

- Workers are between 1/16 to 1/8 inch in length and dark brown to black in color
- Bodies have a greenish-bluish iridescence
- Have extremely long antennae with 12 segments
- Name comes from fast, jerky, and erratic running behavior

Slide 2.22 – Bigheaded Ants

- Small to medium sized ants
- Yellowish to dark-reddish brown with a pair of spines on rear of thorax
- Called bigheaded ants because of the worker’s oversized, heart-shaped head
- Minor workers are easily mistaken for fire ants
- Nests in soils close to structures
- Most common in warmer and drier regions of the U.S.

Slide 2.23 – Harvester Ants

- Medium to large ants
- Reddish to dark-brown in color
- Have a unique “beard” called a psammophore under their head consisting of two rows of inward curving hairs used to help carry soil or seeds
- Not aggressive but can inflict a painful sting
- Nests will have multiple entrance holes, shallow mounds, sometimes clearing large circular areas
 - Very common in grassland and desert areas

Slide 2.24 – Other Nuisance Pest Identification Menu

- Carpenter Ants
- Carpenter Bees
- Crickets
- Silverfish and Firebrats
- Earwigs
- True Bugs
- Ground Beetles
- Centipedes and Millipedes
- Bed Bugs

Slide 2.25 – Carpenter Ants

- Carpenter ants are among the largest ants in North America ranging from 1/4 - 1/2 inch long.

- They are dark red to black in color. They can't sting but can inflict painful bites with their powerful jaws and spray formic acid into the wound, causing a burning sensation.
- Carpenter ants feed on dead and living insects, nectar, fruit juices, and sugary honeydew excreted by plant-sucking insects.
- They enter buildings in search of nesting sites or moisture and can build nests containing several thousand ants.
- Nests they construct indoors are satellites of a larger, parent nest located outside in a live or dead tree, a woodpile, or landscaping materials.
- They don't consume wood like termites but excavate it to make their nests.

Slide 2.26 – Carpenter Bees

- Most carpenter bees are large and robust insects resembling bumblebees
- Their abdomens are shinier than those of bumblebees with fringes of hairs on some segments
- Female carpenter bees bore into wood to make nests
- Their nests usually consist of tunnels 1/2 inch in diameter and 6 - 10 inches deep that are divided into several chambers, each containing an egg and a supply of food
- Nests weaken structural wood and leave unsightly holes and stains on building surfaces

Slide 2.27 – Crickets

- Chirp song is produced by friction of upper wings on each other
- House crickets are 1/2 – 3/4 inch long, light yellowish-brown with three darker brown bands on the head
- Field crickets are 1/2 - 1 1/2 inch long and have more robust darker brown bands on the head
- In some parts of the continental United States (CONUS) they are known to invade buildings—including living quarters

Slide 2.28 – Silverfish and Firebrats

- 1/2 inch long, bodies are covered with scales, long antennae in front, and three long tail like appendages at the hind end
- Silverfish are shiny and silver and require high humidity and temperatures between 70° - 80°F
- Firebrats are mottled gray and prefer dark areas with temperatures of 90°F or more

Slide 2.29 – Earwigs

- Earwigs are brown to black
- They are narrow bodied from 1/4 to 1 inch in length
- They are elongated with pinchers or forceps-like appendages at the end of the abdomen

Slide 2.30 – True Bugs

- Boxelder bugs
- Roughly 1/2 inch long, narrow with a flat back
- Color patterns can range from black to dark brown with three longitudinal red stripes on the thorax and red veins on the wings
- Plant sucking insects that are a nuisance during fall and early warm winter days

Slide 2.31 – Centipedes and Millipedes

- Centipedes are flattened, elongated with one pair of legs on most body segments; 1 – 6 inches long
- Millipedes are brown, rounded bodies, and two pairs of legs on each body segment

Slide 2.32 – Ground Beetles

- Comprise one of the world's largest groups of insects
- They are voracious predators and feed primarily on other insect pests and their larvae
- usually consists of caterpillars, grubs, maggots, snails, and other soft bodied insects
- Many of these beetles have large mandibles used in seizing and devouring preya nuisance during fall and early warm winter days

Slide 2.33 – Bed Bugs

- Bed bugs are blood-sucking insects
- Both nymphs and adults feed on sleeping or sedentary humans, mostly at night
- Found worldwide in association with human habitations
- Feeds on humans, and other species of mammals and birds found near the home
- Adult bed bugs are oval, flattened dorsoventrally, and wingless, about 1/5 inch long, and rusty red or mahogany
- Have well-developed antennae, small compound eyes, and the area behind the head expands forward on either side of the head, bearing many small hairs
- Feeds by piercing the skin with its elongated mouthpart
- Can take up to six times its weight in blood during one feeding event
- Bed bug bites will leave itchy swellings on the skin but have not been shown to transmit diseases to humans

Slide 3.1 – Household & Nuisance Pests Survey Intro

Slide 3.2 – Survey Menu

- Survey Overview
- Cockroach Survey
- Ant Survey
- Other Nuisance Pest Survey

Slide 3.3 – Survey Menu

- Video Closed Captions

Surveys and monitoring pest populations are a must in any Pest Management program. Regular monitoring is key to a successful IPM and ensuring pest thresholds do not get out of control. Weather, temperature, sanitation, and infrastructure all play a role in how well a pest can thrive or not; as pest manager's you must ensure you take an active role to inspect and and survey activity levels and potential threat areas. Once you have completed your survey and determine that an action threshold has been reached, you will then need to determine control measures.

Slide 3.4 – Key Takeaways: Survey Overview

- Regular monitoring is key to a successful IPM and ensuring pest thresholds do not get out of control
- Weather, temperature, sanitation, infrastructure will all play a role in how well a pest can thrive or not

Slide 3.5 – Cockroach Survey Menu

- Cockroach Survey Procedures
- Prevention
- Water Sources
- Food
- Shelter

Slide 3.6 – Cockroach Survey Procedures

- Before you can apply controls to manage cockroach infestations, you must determine the species, their location, and abundance.
- We gain this information through collection and inspection surveys.
- Prevention is the best means of control and should be inspected during your surveys. Because cockroaches are mainly nocturnal, it is easy to overlook them during daytime inspections.
- To compensate for this, use pyrethrum aerosols as inspection tools. This will irritate cockroaches and drive them from their hiding places.
- Spray the pyrethrum directly into cracks and crevices, in torn places in insulation and pipe lagging, behind stainless steel plates, or any other likely hiding place
- Use roach traps to estimate cockroach populations or to collect them for resistance studies.
- Standard cockroach sticky traps (National Stock Number [NSN]: 3740-01-096-1632) are available to detect and monitor cockroach populations
- While you cannot use these traps alone to effectively reduce cockroach populations, you can use them to generate useful data for these purposes:
 - Identifying the pest species present
 - Evaluating the impact of treatment regimens
 - Locating approximate areas where you can use insecticidal treatments
 - Locating where reinfestations are occurring in a facility
- Sticky trap data are most valuable when you use the same number and type of traps per location; this ensures that you subject the cockroaches to the same attractant for consistent results.

Slide 3.7 – Prevention

- Cockroach management involves both preventive and corrective measures.
- The most effective control method for cockroach infestations is thorough sanitation procedures.
- The primary preventive control strategies used in the elimination of cockroach infestations must consider limiting the accessibility of water, food, and shelter.
- This is vital before implementing a chemical treatment program.
- To be effective, you must tailor these control measures to fit the habits of the species requiring management.
- If we remove the water, food and shelter of any pest we will prevent large infestation from happening.

Slide 3.8 – Water Sources

- Recommended water source reduction steps for facility managers or food handling service personnel include:
 - Examining all sinks, bathtubs, wash basins, shower units, and janitors' closets for leak
 - Repairing leaking water sources
 - Ensuring water faucet spigot openings have screens in place—if not, have them installed
 - Ensuring all plumbing water pipelines are free of leaks and condensation buildup
 - Carefully insulating pipelines to prevent cockroaches from using exposed cracks as a shelter
 - Screening off all drains with fine mesh screening
 - Equipping sink drains with strainers having small round holes or slits
 - Rinsing wet and damp sponges or dish cloths with an ammonia and water solution before storing overnight
 - Eliminating standing water in indoor plant pots and covering exposed soil with gravel
 - Ensuring dirty utensils, dishes, bowls, pots, or pans are not accumulated overnight
 - Ensuring pet water and food dishes are not left exposed overnight
 - Inspecting refrigeration units equipped with drip pans monthly to prevent water accumulations

Slide 3.9 – Food

- Removing the availability of food is your second cockroach source reduction priority
- Your responsibility is to ensure facility managers or food handling service personnel implement the following procedures to reduce food accessibility:
 - Storing all food items in airtight containers
 - Never leaving food exposed overnight
 - Emptying trash containers daily and sealing lids in between use
 - Cleaning out sink garbage disposers with a cleaning solution after each use
 - Cleaning off all food preparation and eating surfaces, such as kitchen counters, tables, and floors with a cleaning solution after each use
 - Cleaning and drying utensils, dishes, bowls, pots, and pans immediately after each use
 - Cleaning up grease spots from walls or other surfaces
 - Promptly cleaning up all spilt food especially in carpeted areas and under appliances
 - Thoroughly cleaning sponges, scrubbing pads and brushes after each use
 - Storing soiled clothing articles used in preparing food items in airtight containers to prevent cockroaches from gaining access

Slide 3.10 – Shelter

- The third source reduction procedure includes removing the availability of shelter

- Roaches hide in cracks and crevices during the day. They prefer wood, paper, and cardboard versus metal surfaces for their habitat and can squeeze into places as small as 1/16 inch or larger, where they can touch both the surface above and below them at the same time.
- Removing the availability of shelter includes employing these three steps:
 - Implementing proper supply storage discipline
 - Constructing only with materials that roaches dislike
 - Caulking all possible harborage areas

Slide 3.11 – Ant Survey

- For most infestations, ants soon make their presence known through their appearance, damage, and mounds.
- Surveys are necessary to make a thorough inspection within a facility to determine the ants' point of entry and locate their nest.
- These nests may be within the facility or outdoors.
- Determining effective management measures depends on knowing which ant species require control; therefore, it's often necessary to collect ants to determine specific species.
- Just like with cockroach surveys and control methods, prevention is key to avoiding ant infestations.
- By ensuring sanitation, removing food and shelter, you are less likely to endure an ant infestation.
 - Other things to look for in preventing ant infestations include:
 - Making sure all cracks and crevices are sealed around door frames, windows, and floor boards.
 - Ensuring door sweeps are properly installed on all exterior doors to create a barrier from entering

Slide 3.12 – Other Nuisance Pest Survey Menu

- True Bugs
- Crickets
- Silverfish and Firebrats
- Ground Beetles
- Centipedes and Millipedes
- Bed Bugs

Slide 3.13 – Crickets

- Crickets look and listen for signs of infestations. If found inside, look for entry holes in and around doorways

Slide 3.14 – Silverfish and Firebrats

- To look for silverfish, check bathrooms, laundry rooms and utility rooms for extra moisture or condensation coming from any piping
- Check for cleanliness and lint in areas surrounding a dryer
- To look for firebrats, check furnace areas and behind oven for cleanliness

Slide 3.15 – Centipedes and Millipedes

- Centipedes, Millipedes and Earwigs are normally more active at night
- They feed on decaying organic matter
- Inspect harborage areas such as mulch beds, wood debris, rocks, grass clippings and leaf litter

Slide 3.16 – Ground Beetles

- Ground Beetles are insects that live outside under logs, stones, and other objects
- Sometimes they can be found inside because they are attracted to the light in facilities

Slide 3.17 – True Bugs

- True bugs can become very abundant in buildings that are located near their host plants
- They are one of the most commonly encountered nuisance pests
- They are most noticeable outside in shrubs and grass

Slide 3.18 – Bed Bugs

- To look for silverfish, check bathrooms, laundry rooms and utility rooms for extra moisture or condensation coming from any piping
- Check for cleanliness and lint in areas surrounding a dryer
- To look for firebrats, check furnace areas and behind oven for cleanliness
- A thorough inspection is necessary and the most effective way to detect harborage sites.
- Live and dead bed bugs, cast skins, eggs and specks or little blood spots assist in pinpointing activity levels and if bed bugs are present.
- Particular attention should be paid to the mattresses, box springs, bed frames, headboards, carpet jack, wall hangings, gaps around doors and windows and closets.
- Couches are another harborage area and where they could get their blood meal.
- Dogs, pitfall traps, and detection devices using heat, carbon dioxide (CO₂), and a pheromone are very helpful in attracting and capturing bed bugs if present.

Slide 4.1 – Household & Nuisance Pests Control Intro

Slide 4.2 – Control Menu

- Cockroach Control
- Ant Control
- Other Nuisance Pest Control

Slide 4.3 – Cockroach Control Menu

- General Control Efforts
- Integrated Approach
- Non-Chemical Control
- Chemical Control
- Residual Spray
- Baits

Slide 4.4 – General Control Efforts

- Cockroach control strategies can vary by species.
- Applications of baits, dusts and sprays should be directed into and around harborage areas.

- Baits have been heavily relied on over the past few decades but overuse can result in pest resistance, aversion or avoidance in some circumstances.

Slide 4.5 – Integrated Approach

- An integrated approach should always be used and include the following components:
 - Sanitation, including the elimination of food, water and harborage resources
 - Scheduling cleaning services and garbage removal for later in the day to eliminate food before the most active periods of nocturnal cockroach feeding
 - Pest-proofing the outside of a structure to prevent and exclude any outside insects from
 - Removing clutter in kitchens, food-service areas and food storage areas
 - The use of sticky traps to monitor and pinpoint the areas of highest infestation
 - Vacuuming heaving infestation prior to bait applications
 - Sealing cracks and crevices and voids, repairing cracks in walls and flooring and closing electrical and plumbing fixtures to prevent cockroach movement within the infrastructure of a facility
 - The use of insecticidal dusts in inaccessible void areas and walls
 - A thorough structural analysis to identify potentially unrecognized harborage and access points
 - The use of paste and gel baits in and around areas of suspected harborage
 - The cooperation of customers in reporting infestations and working with pest managers to continually improve sanitation and pest proofing
 - Adequate record keeping to monitor the success of the IPM/ control efforts
 - An insecticide rotation strategy that uses active ingredients from different chemical classes
 - Written protocols or thresholds to ensure the sustainability of an IPM program

Slide 4.6 – Non-Chemical Control

- Implement non-chemical controls such as:
 - Removal of harborage (shelter), including sealing all cracks and crevices
 - Remove food and water sources
 - Trapping is included but primarily used for surveys

Slide 4.7 – Residual Spray

- Residual sprays are commonly used for crack and crevice treatments
- Procedures are as follows:
 - Don PPE
 - Mix desired amount of chemical
 - Select the correct nozzle for the job
 - Apply residual insecticide

Slide 4.8 – Chemical Control

- If non-chemical controls are not feasible or have proven ineffective, chemical controls must be implemented.
- Aerosols and ultra low volume (ULV) treatments are used to stimulate roach activity to move them towards your residual spray.

- They supplement residual treatments to provide a quick, complete kill, or clean out of all roaches. They are useful in the treatment of sewer lines and manholes.
- Dusts are used around electrical outlets and other areas liquid formulations cannot be used.
- Boric acid crystals or paste - stomach poison, it also abrades the cuticle of cockroaches upon contact, causing dehydration and death
- Procedures are as follows:
 - Locate harborage areas
 - Don personal protective equipment (PPE)
 - Carefully apply dust with a bulb duster or another suitable piece of equipment
 - Ensure facility personnel know not to mop or do anything else to cause moisture to come into contact with dust

Slide 4.9 – Baits

- Baits are effective when good sanitation practices are enforced. Safer to the environment, children, and pets because the bait is enclosed in a plastic shell.
- Procedures are as follows:
 - Don PPE
 - Determine most effective locations to apply baits
 - Place a small amount of bait in random spots in desired locations
 - Final step is to change baits out every 90 days to ensure effectiveness

Slide 4.10 – Ant Control Menu

- General Control Efforts
- Non-Chemical Control
- Chemical Control
- Baits

Slide 4.11 – General Control Efforts

- Ant management requires many considerations as to species, colony location, relative size of the infestation and a structures integrity.
- The first step would be to reduce the ant attraction to a structure by improving sanitation, weed management, water management on the exterior and removing unnecessary clutter.
- Exclusion techniques such as sealing, and caulking are very important and helpful in creating a barrier of entry.
- Foraging ants leave trail pheromones for others to follow so cleaning these with soaps and detergents can disrupt their communication by erasing the chemical scent.
- Baits are very effective against many ant species and are highly economical compared to other formulations with higher active ingredient levels.
- Baits also help kill other members of the colony because of the mouth-to-mouth food sharing that occurs in ant colonies.

Slide 4.12 – Non-chemical Control

- Non-chemical controls are the first step in any effective ant control program
- Remove food sources - food is an attractant

- Remove water source - ants need water to survive
- Ant proof - seal up all cracks and entry points

Slide 4.13 – Baits

- Bait should be placed around the nest and along trails. Bait is carried back to the queen and destroys the nest internally.
- After applying chemical controls you should perform a follow up survey to gauge the effectiveness of the treatment.

Slide 4.14 – Chemical Control

- Chemical controls must be implemented after non-chemical controls fail
- Residual sprays have a lasting effect
- Dusts have a very long lasting effect but are somewhat ineffective outdoors due to moisture

Slide 4.15 – Other Nuisance Pest Control Menu

- Chemical Control
- Residual Spray
- Baits

Slide 4.16 – Chemical Control

- Chemical controls are often implemented first to control carpenter ants
- To apply dusts:
 - Probe to locate the nest
 - Drill small holes into wall voids
 - Apply dust into nest areas

Slide 4.17 – Residual Spray

- To apply residual spray, locate areas where ants were observed, or locate ant trails
- Then, apply residual sprays to baseboards or in holes or cracks in the walls and floors

Slide 4.18 – Baits

- Baiting can be used when nests cannot be found
- Place the bait in areas where activity has been seen or is strongly suspected
- Monitor bait for 24 hours after placement
- Remove and replace bait that was ignored
- It is important to locate the main nest and all satellite colonies
- Correct moisture problems and replace damaged wood

Slide 4.19 – Carpenter Bee and Cricket Control Menu

- Carpenter Bee Control
- Cricket Control
- Pesticide Application

Slide 4.20 – Carpenter Bee Control

- Carpenter bees nests can be located in damaged wood
- Apply an insecticidal dust or residual spray to holes
- Seal the holes after 24 hours

Slide 4.21 – Crickets

- Habitat alteration is generally the first step when controlling crickets
- Cricket control procedures are as follows:
 - Caulk, tighten, weather-strip
 - Thin plantings next to foundation
 - Keep grass short
 - Ventilate and remove materials that provide hiding places

Slide 4.22 – Pesticide Application

- Apply pesticides when cultural controls fail
- Spray cracks near foundation and around door stoops and patios
- Apply residual barrier around building
- Spray weeds and grass in mid- summer

Slide 4.23 – Silverfish, Firebrat, and Earwig Control Procedures Menu

- Procedures
- Centipede and Millipede Control
- Insecticide

Slide 4.24 – Procedures

- Vacuum to remove pests inside and remove outdoor harborage areas
- Implement cultural controls such as caulking cracks and crevices, reducing moisture and humidity, ventilating closed rooms, and eliminating standing water
- Treat with residual sprays

Slide 4.25 – Centipede and Millipede Control

- Implement non chemical controls such as:
 - Remove harborage areas
 - Caulk access points
 - Correct moisture problems

Slide 4.26 – Insecticide

- Apply pesticides when cultural controls fail
- Spray cracks near foundation and around door stoops and patios
- Apply residual barrier around building
- Spray weeds and grass in mid- summer

Slide 4.27 – Bedbug Control Procedures and Treatments Menu

- Problem Identification
- Treatment
 - Heat Treatment
 - Cold Treatment
 - Other Treatment

Slide 4.28 – Problem Identification

- To identify the problem, inspect infested areas to determine extent of infestation
- Correctly identify the pest and develop a strategy
- Keep the infestation from spreading
 - Treat any items removed from the infested area

- Thoroughly vacuum the infested areas and dispose of waste

Slide 4.29 – Treatment

- For cultural controls:
 - Reduce clutter
 - Eliminate bed bug habitats
 - Ensure there is adequate space to treat around the infested items
 - Bedding and clothing should be laundered and placed in dryer for at least five minutes to twenty minutes to kill bed bugs and eggs
 - Kill the bed bugs
 - Non-chemical methods should be used when feasible
- If prevention measures and cultural controls are not used, heat or cold treatments may be only temporarily effective since bed bugs may still enter the home.

Slide 4.30 – Heat Treatment

- Raise the house temperature
- 118°F infested item internal temperature kills bugs and eggs within 90 minutes
- 122°F infested item internal temperature kills bugs and eggs immediately
- The air temperature in the room is typically between 135°F-145°F
- Must be done by pest management professionals with specially designed equipment
- Turning on the oven and opening it, with the heat on and windows shut, will not do the job, even in Texas in August
 - Fire hazard
 - Risk of structural damage
 - A commercial steamer with a minimum capacity of 1 gallon of water, preferably with a steam volume control, may be used
 - A commercial steamer is very effective when bed bugs are on the surface of items and up to ¾ inch deep in fabric surfaces
 - The surface temperature immediately after passing the steamer over it must be 160°F-180°F to kill bedbugs
 - The steam itself will be 212°F-230°F
 - Rented/domestic carpet cleaning machines do not reach high enough temperatures to kill bed bugs or eggs

Slide 4.31 – Cold Treatment

- Put infested items in a sealed plastic bag
- Put in 0°F freezer
- Start counting the 4-day exposure time when the center of the object is 0°F, using a remote thermometer
- Dry household items are best:
 - Items that can't be laundered
 - Modern books (not historic or antique)
 - Shoes
 - Jewelry
 - Pictures
 - Toys

- Electronics with no liquid crystal display (LCD) screen
- Do not freeze:
 - Electronics with LCD panels (the “L” stands for “liquid”)
 - Historic or valuable artifacts or books
 - Items that can’t be replaced
 - Items that may be damaged by condensation
 - Items that contain high moisture or liquid inside

Slide 4.32 – Other Treatment

- Don’t open windows and turn off heat when the temperature outside is 0°F or lower
- Risk of structural damage
- Probably won’t kill bed bugs and eggs
- Most domestic freezers will not maintain low enough temperatures for this control
- Applying chemicals is usually the fastest way to kill bed bugs:
 - Select a pesticide that is labeled for bed bug control
 - Apply a residual spray to the infested furniture and the surrounding area
 - Spray walls around the bed to a height of 4 feet and 6 feet for bunk beds

Slide 5.1 – Course Completion

Congratulations, you have completed the household & nuisance pests lesson. Please click complete lesson to receive credit.

3E453 – Pest Management Journeyman

Module 3, Lesson 3, Task 1 (10.3.1, 10.3.3, 10.3.4) Venomous Arthropods

Slide 1.1 – Introductory Slide

Slide 1.2 – Lesson Title Slide

3E4X3 Career Development Course

10.3.1, 10.3.3, 10.3.4 Venomous Arthropods

Slide 1.3 – Instructions

Welcome to the lesson on Venomous Arthropod.

- Upon completion, and without reference, you must be able to identify the relationship of basic facts and state general principles about the identification of venomous arthropods with at least 75% accuracy.

Slide 1.4 – Overview

In this section, we will cover the following topics:

- Identification of Venomous Arthropods
- Survey of Venomous Arthropods
- Venomous Arthropods Control Measures

Slide 2.1 – Identification of Venomous Arthropods Intro

Slide 2.2 – Venomous Arthropod Identification

- Types of Venom
 - Hemolytic toxin causes a breakdown of red blood cells. It may kill large blocks of body tissue in the area of the envenomization (bite).
 - Neurotoxin is a systematic toxin that affects the nervous system. It inhibits reflexes and may cause shock in severe cases
 - Urticating toxin simply produces welts (raised areas) on the skin. Vesicating toxin produces blisters on the skin.
 - Hemorrhagic toxin prevents normal clotting ability of blood. It causes a reddening of the skin in the area of envenomization.
- Methods of Envenomization
 - Stings
 - Bites

- Contact
- Pinching
- First Aid of Hymenoptera Stings
 - If you have received multiple stings or if you are allergic to stings, you should receive immediate medical treatment.
 - Bee stingers have barbs on them, so the stinger remains in the victim.
 - To remove the stinger, place the sharp edge of a knife blade immediately below the sting entrance and position it flat against the skin with the sharp edge closest to the exposed portion of the sting.
 - Carefully pull the blade in the same direction as the angle of the stinger to avoid breaking it off.
 - This method prevents squeezing more venom from the poison sac.
 - NOTE: Do Not Use Tweezers.

Slide 2.3 – Honeybees

- Overview
 - A social insect that lives in colonies with as many as 60,000 members.
 - Workers are most likely seen flying around.
 - 7/16 to 5/8 of an inch long.
 - They have well developed heads with two short antennae and large compound eyes which can distinguish colors, but cannot focus.
 - The basic colors are fuzzy yellow-brown to black.
 - Two pairs of wings with the hind pair being smaller than the front pair.
 - The abdomen is striped, and the females have stingers at their posterior ends.
 - The hind tibia (the bottom part of the back legs) are modified to form pollen baskets, which are used to collect and transport nectar and pollen.
 - There are three castes or types of individuals.
- Queen
 - Is the only fertile member
 - She produces all the eggs
- Drones
 - Only purpose is to fertilize the queen
 - After mating they are driven off by the workers
- Worker
 - They do all the work for the colony such as gathering food and take care of the young as well as the queen.
 - Collect nectar and pollen for the colony.
 - Producers of bees wax which is used extensively as a sealant (because it does not harden and remains pliable for many years) also used for lubricating bow strings, and some people use it as a natural chewing gum.

Slide 2.4 – Africanized Honeybees

- Africanized honeybees (AHB) are a strain of *Apis mellifera*, the same species introduced from Europe that produces our honey and pollinates many of our plants.
- Their aggressiveness and stinging behavior, increases 6 to 10 times as many stings compared to the European honeybee, which provided the nickname “killer bee”.

- African bees were brought to Brazil in 1956 by biologists wanting to create an African/European hybrid that would perform well in the South American climate.
- The newly released AHBs survived exceptionally well in South America—so well, in fact, that they quickly displaced existing European strains, even those maintained by commercial beekeepers.
- As they spread, problems arose and the differences between the domesticated European bees and AHBs soon became apparent.
- Africanized honeybees are:
 - Extremely sensitive to the slightest disturbance, and the hive responds with massive and persistent stinging attacks
 - Difficult to manage and have a strong tendency to leave existing hives and settle elsewhere
 - Poor producers of surplus honey

Slide 2.5 – Bumblebee

- Nest in holes in the ground
- They live in colonies during the summer but only the queen survives the winter
- There are many queens in the colony (unlike the honeybee where there is only one)
- They have no worker caste
- The undeveloped queens carry out all chores
- They are much larger than honeybees and much hairier

Slide 2.6 – Social Wasp

- A distinct head with chewing mouthparts, short and large compound eyes.
- The thorax and abdomen are connected by a "pinched waist" and brightly marked with yellow, red, or brown markings on a black background.
- They have four wings that, depending on the species, can be clear to smoky brown in color.
- The abdomen is spindle shaped with a strong stinger at the posterior end.
- They build large nests which hang from almost any object.
- Colony consists of three castes which are like the honeybee.

Slide 2.7 – Hornets

- Rather large (about 1 inch long), and black and whitish yellow in color
- White markings distinguish it from the true yellow jacket
- Thorax and abdomen are not separated as distinctly as the wasp
- Construct a paper like nest that is completely enclosed with a paper like covering which resembles a "bloated football"

Slide 2.8 – Spiders

- Black Widow
 - The female is shiny black with a red hourglass shaped marking on the underside of the large and round abdomen.
 - Females are about a half inch long with the males about half the size of the females.
 - The males cannot penetrate human skin due to their weak mouth parts.

- Females produce several egg sacs each containing an average of 200 eggs.
- Eggs are white and soft (cottony appearance).
- Females have poison glands and will bite if handled roughly or disturbed, but their normal food is other insects.
- **Brown Widow**
 - The brown widow is a little smaller than the black widow and varies in color from gray to light brown to almost black.
 - The dorsal abdominal pattern is rather intricate and variable, and the hourglass is brownish yellow.
 - They can be found in tropical areas of the world, particularly in Africa and in the Gulf Coast states within the United States.
 - They are considered much less aggressive than the black widow and rarely bite people.
- **Brown Recluse**
 - Brownish tan in color with a fiddle shaped marking on the cephalothorax (Fiddleback is the common nickname).
 - It has a small body with long legs.
 - Six eyes are present where most other spiders have eight.
 - Females produce one to five egg sacs containing about 50 eggs each.
 - They can be found in almost any place that has been undisturbed for a long period of time.
 - Both the male and female can inflict painful bites that cause localized tissue damage at the site of the bite possibly causing an unsightly scar.
 - They seldom bite unless disturbed or handled.
 - Unlike the bite of the black widow, that of the brown recluse is localized and produces considerable local necrosis or tissue damage, which may ultimately produce an unsightly scar.

Slide 2.9 – Scorpion: Overview

- There are six families with over 650 species distributed throughout the tropics, subtropics, and warm temperate parts of the world.
- Medical importance of scorpions is determined by their habits and venom potency, not by their size.
- They do not lay eggs, but give birth to living young which are carried on the mothers back for quite some time.
- They are nocturnal and are seldom seen during the day.
- They can survive without food and water for up to six months.

Slide 2.10 – Scorpion: Body Parts

- **Color**
 - Colors vary from nearly black to straw color
- **Tail**
 - The last six abdominal segments form the tail with the end segment modified in the form of a hooked stinger.

- The tail is carried arched over the back and the stinger is inserted into the victim by a quick forward thrust.
- Body
 - The body has two divisions:
 - Anterior, unsegmented cephalothorax
 - Posterior, segmented abdomen has six segments.
- Legs
 - They have four pairs of legs and one pair of large claws called pedipalps

Slide 2.11 – Scorpion: Medical Importance

- Centruroides are found in portions of the southwest United States and Mexico.
- Tityus is found in central and south America.
- Buthus and Androtonus are found in southern Europe, the Middle East, and North Africa.
- Parabuthus is found in South Africa.
- Centruroides sculpturatus is one of the most poisonous scorpions known to occur in the United States (US), found mainly in southern Arizona, although it is fairly common in other western and southwestern states.
- Centruroides gertschi is a color variant of Centruroides sculpturatus.
- It is basically yellow in color with irregular black stripes down its entire back.
- It is a widely distributed southern scorpion (found from Florida to Arizona).
- It is relatively harmless but has a painful sting.
- When stung by this species, the victim usually feels a sharp pain, which goes away with time, and normally will have some swelling.

Slide 2.12 – Centipedes: Overview

- All centipedes are predacious and have well-developed poison glands used to kill their prey.

Slide 2.13 – Centipedes: Body Parts

- Head
 - The head has a pair of extremely long multi-jointed antennae, a pair of strong mandibles, and two pairs of maxillae.
- Size
 - The head has a pair of extremely long multi-jointed antennae, a pair of strong mandibles, and two pairs of maxillae.
- Body
 - Centipedes are flattened dorsoventrally.
 - Body has a distinct head and 15 to 170 or more similar body segments.
 - Each segment has one pair of tracheal openings and one pair of seven-jointed legs.
- Legs
 - Adults of several species have shining greenish or blackish bodies and orange or red legs and heads.

- Some are yellowish with dull red longitudinal bands, and still others are markedly phosphorescent.

Slide 2.14 – Centipedes: Medical Importance

- Most centipedes are harmless to people since few species have fangs strong enough to penetrate human skin.
- They bite only when molested or threatened.
- The secretion they inject is primarily a digestive enzyme, containing only a small portion of venom.

Slide 3.1 – Survey of Venomous Arthropods Intro

Slide 3.2 – Survey Principles

- The type and number of venomous arthropods will vary depending on your location.
- Venomous arthropod surveys will most often occur after a problem is reported.
- Non-pest management personnel can mistake a harmless pest as a venomous pest.
- A survey will help determine if a problem exists and what control measures may need to be implemented.
- Survey procedures for all venomous arthropods are very similar.
- The location of the survey will depend on what pest is suspected to be present.
- Ensure the customer knows where the arthropod is located as this is most important.
- Have the requester keep an eye on the venomous arthropod.

Slide 3.3 – Survey Methods Menu

- Honeybees
- Wasp and Hornet
- Spiders
- Scorpions
- Centipedes

Slide 3.4 – Scorpions

- Location Identification
 - Identify location based off customer complaint
- Equipment
 - Gather equipment:
 - PPE- gloves
 - Flashlight
 - Long stick probe to handle or direct scorpion
- Survey
 - Inspect common scorpion habitat areas
 - Under and around objects and rock beds
 - Storage containers
 - Wall voids
 - Light fixtures
 - Identify any live scorpions
 - Determine control method

Slide 3.5 – Wasp and Hornet

- Location Identification
 - Identify location based on the details provided by the customer
- Equipment
 - Gather needed equipment:
 - PPE- bee suit, gloves, head net
 - Ladder
 - Flashlight
 - Thermal imaging camera
 - Used to find bees inside a wall void or inside a ceiling
 - Any additional equipment needed based on location of the survey
- Survey
 - Search and locate the nest.
 - Identify species based on how the nests looks and is constructed. Remember:
 - Social wasps' nests are umbrella shaped and hang from almost any objects.
 - Yellow jacket nests can take on a “super structure” shape and only have one opening to the nest.
 - Hornets' nests are usually located in trees, attic rafters or other covered areas and resemble a bloated football appearance.
 - One you have properly identified the type of pest, determine if controls are needed.
 - If controls are needed, determine best control methods for the given scenario.

Slide 3.6 – Centipedes

- Location Identification
 - Identify location based off customer complaint and observations
- Equipment
 - Gather equipment:
 - PPE – gloves
 - Flashlight
 - Long stick probe to handle or direct centipede
- Survey
 - Inspection of common areas:
 - Under stones, rubbish, leaves, logs and other dark areas
 - Identify any live specimens
 - Determine control methods if needed

Slide 3.7 – Honeybees

- Location Identification
 - Identify location based on the customer complaint:
 - Honeybees are known to build permanent colonies that may survive indefinitely
 - Periodically, a swarm of workers will split from the main colony to start a new one

- Swarming honeybees are not considered a problem until they pose a risk to the health and safety of the general public
- Equipment
 - Gather needed equipment:
 - Personal protective equipment (PPE)- bee suit, gloves, head net
 - Ladder
 - Flashlight
 - Thermal imaging camera
 - Used to find bees inside a wall void or inside a ceiling
 - Any additional equipment needed based on location of the survey
- Survey
 - Locate Bees:
 - Determine if bees are established and making a nest or if they are swarming:
 - Many times, bees will create combs and it looks as though they are building a nest, this may not be the case though as the workers are always carrying out their duties and producing honey even when they are swarming
 - Determine if bees are docile or aggressive:
 - Africanized honeybees are much more aggressive and will readily attack to defend their nest
 - Keep in mind bees are more active in warmer and brighter temperatures
 - Just because they are very active does not mean they are Africanized
 - Locate entry and exit points from the hive and any honeycombs
 - Determine control procedures

Slide 3.8 – Spiders

- Location Identification
 - Locate survey area based on customer complaint and observations
- Equipment
 - Gather equipment:
 - PPE- gloves, coveralls
 - Flashlight
 - Ladder
 - Field guide to help in identification
- Survey
 - Inspect common habitats:
 - Black widow spiders prefer dark, damp areas
 - Brown recluse spiders prefer dry undisturbed areas
 - Behind pictures, within or under furniture
 - Outdoors, brown recluse spiders can be found under large rocks and discarded lumber

- Look for signs of spider activity:
 - Irregular shaped spider webs with insects within the webs
- Look for egg sacs that could resemble small cotton balls:
 - Determine species of spider
 - Determine control methods, if needed

Slide 4.1 – Venomous Arthropods Control Measures Intro

Slide 4.2 – Control Measures Overview

- Once it has been determined that a threshold has been crossed, pest managers must produce a control strategy to effectively control a pest population.
- Integrated pest management (IPM) is a combination of multiple methods to produce the best plan for the present pest at the given time that presents the longest lasting results.
- Depending on the situation, a small action such as increasing sanitation and monitoring would suffice.
- In some cases, multiple actions will be needed to include using pesticides.
- Venomous arthropods pose a large risk in injury and health related illnesses if not properly controlled

Slide 4.3 – Honeybee Control

- Overview
 - When bees colonize an area frequented by humans or domestic animals, they become a pest or health risk that needs to be removed or eliminated.
 - Bees that need to be removed fall into three categories: bee swarms, established colonies, and bumble
- Equipment
 - Gather Equipment/PPE
 - Bee suit
 - Ladder
 - Colony removal equipment
 - Box
 - Putty knife to remove honeycombs
 - Apply non-chemical controls such as physically removing the swarm by placing it into a trash bag and relocating it to an uninhabited area.
 - If bees cannot be removed by hand, spray them with soapy water using a high-volume spray
 - One cup of soap per gallon is recommended
 - Avoid using a fine mist
 - Apply chemical controls if non-chemical controls are impractical.
 - The Environmental Protection Agency (EPA) has taken immediate steps that changed pesticide labels, so they better protect bees by being clearer and more precise in their direction for pesticide application.
 - Read the label and ensure you are applying the chemical as directed per the label. The revised labeling includes specific times when pesticides are not allowed to be applied.

- **Swarming Bee Control**
 - Locate the bees:
 - Most swarms will leave on their own
 - Swarming bees are looking for a new hive location, and are most likely resting before moving on to their new location
 - Swarming is a part of the bee's normal reproductive process, and they are usually not defensive or aggressive
 - Only in unusual situations will a swarm remain to build a comb
 - Determine if control is necessary:
 - Contact an off-base beekeeper/apiary to see if they can relocate the swarm
 - Many beekeepers will do this free of charge, since they will acquire a new colony of bees for their hives
 - Having a beekeeper remove a colony is very important as it salvages their beneficial contribution as honey producers and plant pollinators
 - If the swarm must be removed immediately, i.e. an aircraft that needs to fly, proceed with removal procedures.
- **Established Colony Control**
 - Locate bee colony:
 - Determine if colony must be controlled
 - Determine if chemical or non-chemical methods will be used
 - Don PPE:
 - Bee suit
 - If possible, remove and relocate the colony
 - If relocation is not possible, apply an approved pesticide to kill bees
 - After killing adult bees, the colony should be completely removed
 - Removed by hand
 - Removed by vacuum
 - Contact insecticides provide a quick kill
 - Residual insecticides should be applied to cracks, crevices, and baseboards
 - Perform a follow up survey to ensure all bees are killed

Slide 4.4 – Bumblebee Control

- **Locate the bumblebee nest**
 - Don PPE bee suit
 - Treat nest and soil around nest with an approved insecticide
 - For maximum personal protection, spray solutions and emulsion into and onto a bumblebee nest from a distance
 - Remove and destroy nest

Slide 4.5 – Wasp and Hornet Control

- **Basic sanitation and cleaning will disrupt wasps from becoming comfortable in each area and making nests.**
 - The following procedures are recommended for control:
 - Locate the nest after an incident is reported

- Come back later in the day or early the next morning as wasps, and hornets are calmer in cooler temperatures
- Don PPE
 - Bee suit
 - Shine a red-lens flashlight to visually confuse the pests
- Determine if chemicals must be used
- Wasps and hornets are not normally a problem unless they build their nests in populated areas.
- Apply insecticides to the nests and adult pests present
- Remove and destroy the nest.

Slide 4.6 – Spider Control

- Management measures for spiders include individual awareness, physical measures and pesticidal applications.
- Physical methods such as cleaning up all possible breeding areas is of considerable value in managing any spiders.
- Be sure to remove and destroy any webs and egg sacs.
- Spiders in structures can be controlled by sanitation, habitat alteration and judicious use of pesticides.
- Exposure can be reduced by careful inspection and elimination of harborage sites.
- Most spiders are not noticed and can be controlled by proper sanitation and exclusion practices.
 - Common control procedures for spiders that have become pests include:
 - Locate the spider and its web
 - Determine the species
 - Determine if controls are needed
 - Use physical controls to kill the spider and remove the webs
- Apply an approved insecticide if spiders cannot be found or physical controls are not practical.
- Insecticidal contact and dusts can provide a quick kill and many aerosols will make them drop from their webs so they can easily be crushed.
- Residual insecticides can be applied to cracks, crevices, and baseboards but are less effective due to spiders not always needing to encounter those areas.

Slide 4.7 – Scorpion Control

- Avoidance is the best method of physical control and should include picking up objects carefully as not to be stung by scorpions hiding underneath.
- Always shake out shoes and slippers before placing feet into them.
- Do not walk around barefoot, especially in the dark.
- Shakeout all clothing and do not store on the floor.
- Keeping beds away from walls and placing traps around bed legs are a great way to reduce likelihood of scorpions being able to climb up a bed.
 - Sanitation is also key in preventing scorpion infestations:
 - Removal and destruction of harborage areas
- Eliminate and exclude insects from the premises

- Scorpions' main food source are insects; remove the insects and the less likely they will be around
- Common control procedures:
 - Locate the pest
 - Stomp on scorpion, or crush with a heavy object
 - Perform a thorough inspection to ensure no other scorpions are near

Slide 4.8 – Centipede Control

- Physical, mechanical and sanitation are primarily your best control for centipedes:
 - Properly screening houses usually keeps them out
 - Doors need to fit tightly
- Common control procedures:
 - Locate the pest
 - Stomp on centipede, or crush with a heavy object
- Perform a thorough inspection to ensure no other centipedes are near
- Applying residual dusts and sprays can be done indoors and outdoors for control
- If removing physically always ensure to wear gloves as centipedes provide a painful bite

Slide 5.1 – Course Completion

Congratulations, you have completed the venomous arthropods lesson. Please click complete lesson to receive credit.

3E453 – Pest Management Journeyman

Module 3, Lesson 4, Task 1 (10.4.1, 10.4.3, 10.4.5) Venomous/Non-Venomous Reptiles Identification

Slide 1.1 – Introductory Slide

Slide 1.2 – Lesson Title Slide

3E4X3 Career Development Course

10.4.1, 10.4.3, 10.4.5 Venomous/Non-Venomous Reptiles Identification

Slide 1.3 – Instructions

Welcome to the venomous/non-venomous reptiles lesson.

- Upon completion of this lesson, you must be able to successfully identify basic facts and principles relating to the identification of venomous and non-venomous reptiles with at least 75% accuracy.

Slide 1.4 – Overview and Characteristics

- Overview
 - Most snakes are not venomous, and are beneficial because of the number of rodents and insects they eat
 - Although venomous snakes have no place in a settled community, non-venomous snakes should be given as much consideration as any other animal that directly or indirectly assists in combating pests
 - Snakes are considered “cold-blooded” animals because their body temperature varies from that of their surroundings
 - In reptiles, body temperature is maintained by moving to and from warm places and not by internal controls as in birds and mammals
 - Most snakes die off in intense heat or subzero temperatures
 - In temperate climates, snakes will hibernate
 - Their survival depends on evading frost, and they will crawl into stumps, holes in the ground, or rock crevices where frost does not penetrate
- Characteristics
 - Some snakes lay eggs, while others give birth to living young that hatch from eggs retained within the female’s body
 - Snakes are generally passive by nature and will avoid contact with people unless cornered or injured in some way
 - Snakes do not have external ears and are deaf
 - Extremely sensitive to vibrations and small differences in temperature
 - All snakes are predatory and swallow their prey whole

- VENOMOUS REPTILES
 - Snakes are not poisonous
 - If you bite something and you become ill, it is poisonous
 - If something bites you and you become ill, it is venomous
 - Snakes inject venom, making them venomous
- VENOMOUS REPTILES
 - Usually have a triangular-shaped or rounded head depending on the family
 - During the daytime, pupils look like slits
 - A visible line separates two rows of scales at the end of the tail

Slide 2.1 – Venomous Snakes Intro

Slide 2.2 – Family Elapidae

1. They are found in tropical and subtropical regions.
2. Family includes the highly venomous, krait, mambas, and coral snakes.
3. All are venomous, some highly venomous.
4. Have round pupils.
5. Have hollow, fixed fangs used to inject venom.
6. Most have long, slender bodies with smooth scales with no distinction between the size of the head and the rest of the body.
7. Most Elapidae are oviparous, meaning they lay eggs.
8. Most are active hunters (as opposed to ambush predators).
9. Two species found in the United States (U.S.) are the Arizona and Eastern Coral Snake.

Slide 2.3 – Arizona Coral Snake

- 1-2 feet long
- Blunt-nosed
- Glossy with alternating wide red and black rings alternating with narrow yellow rings encircling the body
- The coral snakes have prominent rings around their bodies in the sequence of black, yellow, or white and red which is where the sayings "Red touch Yellow, kill a Fellow" and "Red touch Black, friend of Jack" originated

Slide 2.4 – Eastern Coral Snake

- 2-3 feet long
- Have bulbous, almost neckless heads
- Have wide red and black rings separated by narrow yellow rings that go around the body
- Red rings are usually speckled with black

Slide 3.1 – Venomous Snakes Intro

Slide 3.2 – Family Viperidae

1. Commonly called pit vipers due to having an opening or "pit" on either side of the head between the eye and nostril.
2. Pits are heat sensitive openings used locate warm-blooded prey.
3. Stout with their heads distinctly wider than the rest of their body
4. Bodies are patterned with blotches of cross bands.

5. Possess curved retractable fangs on the upper jaw.
6. Each fang connects to a tube connecting to a venom gland located behind the eye.
7. Eyes have vertical pupils that resemble cat's eyes.
8. The scale on the underside of the snake's tails are undivided
9. Three commonly found in the U.S. are the copperhead, water moccasin or also known as the cottonmouth and rattle snakes.

Slide 3.3 – Copperhead

- Most commonly seen snake
- Most likely to bite if disturbed
- 2-3 feet in length
- Dorsal pattern is a series of dark, chestnut-brown/reddish-brown cross bands, each shaped like an hourglass
- Young copperheads are more grayish in color, 8-10 inches long
- Will usually vibrate its tail rapidly and emit a "strong-smelling musk"

Slide 3.4 – Water Moccasin

- Distinctive blocky, triangular head; a thick body; and a dangerous bite
- Semiaquatic
- Heat-sensing facial pits between their eyes and nostrils
- 2-4 feet in length
- Dark stripes by each nostril and pale snouts
- Their coloration varies from dark brown or black to olive, banded brown or yellow
- Their bellies are paler than their backs

Slide 3.5 – Rattlesnakes

- Named for the rattle at the tip of their "tail"
- Hollow, like a maraca, with little bits of keratin (same material as fingernails) shaking around inside
- In areas where feral hog populations are out of control, rattlesnakes have been found to not rattle, since the rattling signals the feral hogs, who find and eat them
- Heat-sensing facial pits
- Rattlesnake venom, in fact a toxic saliva, is among the most complex substances known, a mixture of enzymes unique to pit vipers that destroys blood or paralyzes nerves
- Can detect the heat from a candle flame 30 feet away
- Range from 1-8 feet depending on the type of rattlesnake
- Dual vision
- Eastern Diamondback
 - Largest venomous snake in North America
 - Live in the dry, pine flatwoods, sandy woodlands, and coastal scrub habitats from southern North Carolina to Florida and west to Louisiana
 - Pattern of yellow- bordered, light- centered black diamonds
 - Can accurately strike at up to one-third
- Western Diamondback
 - 2nd largest venomous snakes in North America

- Up to 7 feet long
- Back is covered with dark diamond- shaped patches lined with lighter scales
- Rattle has a unique black-and- white, raccoon- like color scheme
- Unlike many other rattlers who flee, the Western diamondback will stand its ground, coil, and hiss when threatened
- Inhabit dry, rocky, shrub- covered terrain
- Timber Rattlesnake
 - 3-5 feet long
 - Heavy- bodied snake
 - Reddish brown stripe running down the center of the back is disrupted by a series of large, black, chevron- like cross bands on the pinkish gray or tan body
 - Eyes have vertical pupils that resemble cat's eyes
 - Inhabit foothills, rocky canyons, and ravines

Slide 4.1 – Non-Venomous Snakes

Slide 4.2 – Family Colubridae

1. All non-venomous snakes in the United States belong to this family.
2. These snakes have round pupils and the scales on the underside of the tail are divided.
3. Usually have a rounded head.
4. Pupils are circular.
5. Scales of these snakes are divided on the underside of the tail.
6. Often do not have a heat sensing pit on the head.
7. Some of the more common Examples include garter and king snakes.

Slide 4.3 – Garter Snake

- Most common snakes in North America
- Spanning from Canada to Florida
- Relatively harmless, although some species do possess a mild neurotoxic venom
- Relatively small, usually between 2 to 3 feet long
- Live in woodlands, meadows and grassy knolls
- Wide variety of colors depending on the species, but “most have three longitudinal stripes, one in the center of the back and one on each lower side of the body”
- Some garter snakes have intricate splotchy patterns between their stripes, making them look checkered

Slide 4.4 – King Snake

- Medium-size non-venomous snakes that kill by constriction
- They are called king snakes because they sometimes eat other snakes
- King snakes have vibrant patterns on their skins with vivid contrasting colors
- Bands and speckles break up the snake's body outline
- Coloring can be understood by their geographic location
- The farther west one goes in the eastern king snake's range, the more the snakes' coloring resembles the black king snake
- Sometimes called "chain snakes" or "chain kings" because their distinctive markings can resemble a chain linked across their bodies

- Live in forests, grasslands, suburbia, and rocky areas in fields and deserts

Slide 5.1 – Venomous Snakes Intro

Slide 5.2 – Purpose and Common Standards Video

- Video Closed Captions

Although most snakes are more afraid of people than people are of snakes, all military personnel should be taught to avoid contact with snakes. If a snake does crawl into a military work or living area, personnel should call their pest management, preventive medicine, or veterinary unit for assistance in removing it. Even trained personnel should never attempt to handle snakes without the proper equipment such as snake tongs and hooks. Snake surveys are usually conducted after a sighting has been reported. Snakes are most often seen in the fall and spring season as they search for food or move to and from hibernation areas. A thorough survey will help identify snakes present and their abundance. Pest managers must be proficient at performing surveying and knowing where and what to look for. Survey will help put the customer at ease even if a snake is not found.

Slide 5.3 – Takeaways

- If a snake does crawl into a military work or living area, personnel should call their pest management, preventive medicine, or veterinary unit for assistance in removing it
- Even trained personnel should never attempt to handle snakes without the proper equipment such as snake tongs and hooks
- Pest managers must be proficient at performing surveying and knowing where and what to look for

Slide 5.4 – Safety Considerations

- Caution
 - Do not handle freshly killed snakes; they can still inflict serious, if not fatal, bites by reflex action.
- PPE
 - Do not enter snake-infested areas without protective clothing, such as leather gloves with gauntlets and high-top leather boots.
- Debris
 - Do not turn debris or other objects away from view; use them as a shield against any snake that might be underneath.
- Notice
 - Avoid unnecessary walking about at twilight, during the night, and shortly after sunrise, unless you are wearing high-top boots.
- Avoid
 - Do not place hands (gloved or ungloved) on rock ledges, under boards, in hollow logs, or near places that snakes particularly enjoy, such as sunny rocks near their dens.
- First Aid
 - The only first aid non-medical people should administer is to immobilize the limb where the bite has occurred and transport the victim to the nearest medical facility.

- If it takes more than 30 minutes to get to a medical facility, place ice-filled towels around the bite area and a loose-fitting tourniquet between the bite site and the patient's heart.
- Loosen the tourniquet for a few minutes every hour or so if the time needed to transport the patient exceeds an hour.

Slide 5.5 – Survey Methods

- The first step in any snake survey is to talk to the requester to verify location of snake and gather as much information as possible before you arrive at the facility
- Gather your equipment and PPE; normally already on the work truck:
 - Snake tongs
 - Snake hook
 - Bucket or burlap sack
- If snake cannot be located look for signs of snake such as
- Skin- snakes shed their skin and discarded skin can be used to determine species and size of snake
- Nests/ dens
- Eggs
- Research the biology and common habitats of the type of snake that was reported
- Determine species once snake is found
- Determine control procedures

Slide 6.1 – Venomous Snakes Intro

Slide 6.2 – Overview

- The first consideration in managing a snake problem is to find out what type of snake you are dealing with
- Once you know the type of snake you can determine the risk associated and correct control methods
- Since snakes and their habits are varied, the management measures discussed on the following slides are very general
- One or more of these methods may be applicable in any set of circumstances

Slide 6.3 – Snake Proofing

- Snakes will occasionally enter buildings by accident or in search for food or shelter
- You can stop them by:
 - Sealing all openings around the foundation
 - Ensure doors, screens, and windows fit tightly
 - Cover drains and vents with ¼ inch metal screening
 - Remove snake harborage areas such as rock piles, wood piles, tall grass, weeds and brush
 - Removing rodents will help reduce snake populations

Slide 6.4 – Search and Killing

- Most obvious and sometimes the most practical way to manage snakes

- Can quickly reduce numbers in a given area, even more effective in the spring when snakes are more sluggish following hibernation periods
- Killing of snakes should only be done as a last resort
- All other control methods should be continuously implemented to exclude them, modify habitat, reduce food sources, and/or to relocate the snakes to an uninhabited area
- Contact your Natural Resource Program Manager and local wildlife officials before initiating snake control programs to verify if the species involved is protected by law

Slide 6.5 – Contingency Considerations

- In overseas operations, preventive medicine and veterinary units should be familiar with non-venomous and venomous snakes that may be found in their area
- When possible, this information should be obtained before departing to a contingency area
- Consult the US Army Center for Health Promotion and Preventive Medicine (USACHPPM) Entomological Sciences Program, Aberdeen Proving Ground, MD 21010–5403 for a poster containing information on the local snakes for a given region. The following is a list of available posters found on the USACHPPM website:
- <https://ephc.amedd.army.mil/HIPECatalog/searchResults.aspx?c=4&s=0&f=0&l=0&t>
- When the mission cannot afford the delay of bringing in specialists, or when in doubt, teach deployed personnel to not handle and to avoid all snakes
- It is better to avoid all snakes versus verifying whether they are venomous or non-venomous after a bite has already occurred
- Also, deployed personnel must avoid handling dead snakes
- Dead snakes still have a biting reflex which can lead to an inadvertent bite
- Special training on snakes likely to be encountered should be part of the initial in-country briefing given to all troops being deployed in areas where poisonous snakes are known to be a problem
- If you are deploying to an area prone to have snakes, familiarize yourself with the local snake species you will most likely encounter. Use the informational posters produced by USACHPPM or other host nation identification manuals
- If and when in doubt, contact your Natural Resource Program Manager, Major Command (MAJCOM) Pest Management Consultant, and local or host nation authorities

Slide 7.1 – Course Completion

Congratulations, you have completed the venomous/non-venomous reptiles identification lesson. Please click complete lesson to receive credit.

3E453 – Pest Management Journeyman

Module 3, Lesson 5, Task 1 (10.5.1, 10.6.3, 10.6.4) Structural Pest Identification

Slide 1.1 – Introductory Slide

Slide 1.2 – Lesson Title Slide

3E4X3 Career Development Course

10.5.1, 10.6.3, 10.6.4 Structural Pest Identification

Slide 1.3 – Instructions

Welcome to the Structural Pest Identification lesson.

- Upon completion of this lesson, you must be able to successfully identify basic facts and principles relating to the identification of structural pest with at least 75% accuracy.

Overview

In this section, we will cover the following topics:

- Overview
- Termite and Ant Biology
- Dampwood Termites and Additional Pests
- Wood Destroying Fungi
- Structural Pest Survey
- Structural Pest Control Measures

Slide 2.1 – Overview Intro

Slide 2.2 – Overview Video

- Video Closed Caption

Structural pests weaken and destroy structures. Much like stored products pests, structural pests are also considered “economic pests”

because they have a direct impact on funding when we must replace wooden structures which they destroy by infestation. Wood-destroying organisms such as termites, beetles, and fungi cause significant structural damage and economic loss each year. The most known insects that destroy wood in structures are termites and beetles, others include carpenter ants and carpenter bees. The DoD is concerned about these organisms because it has billions of dollars invested in wooden structures and wood products. Wood is also an essential building material

for constructing temporary and stationary structures during military build-ups and contingency operations.

Slide 2.3 – Key Takeaways: Overview

- Structural pests weaken and destroy structures
- The most known insects that destroy wood in structures are termites and beetles
- The Department of Defense (DoD) is concerned about these organisms because it has billions of dollars invested in wooden structures and wood products

Slide 2.4 – Termites (General Information)

- Termite management costs are second only to those for cockroach control.
- From an economic standpoint, termites are the most destructive insect pests found on military installations.
- These insects can damage a building so severely that it must be replaced.
- They eat wood and other cellulose products such as paper, cardboard, and fiber board, and they destroy various wood products such as structural timbers, pallets, crates, and furniture.
- As they search for food, they damage many materials they do not normally eat
- .Example: As subterranean termites tunnel through the ground, they can penetrate lead- and plastic-covered electric cables and cause electrical system failure.
- Their presence may take years to notice because they can live for years in tree stumps or lumber beneath concrete buildings before they penetrate hairline cracks in a concrete floor, concrete block wall, or expansion joint.
- Once inside, they search for food in areas like an interior doorframe or immobile furniture.
- Termites are the only insects in the Order Isoptera and are commonly confused with ants because of their appearance and size.

Slide 3.1 – Environmental Protection Agency (EPA) Intro

Slide 3.2 – Termite and Ant Biology Video

- Video Closed Captions

Termites have four wings of about equal length the wings are nearly twice as long as the body. Ant wings are only a little longer than the body and the hind pair is much shorter than the front pair. Termites do not have a pinched or narrow waist. Ants have a pinched waist. Termite antenna are straight and beadlike. Ant antenna are elbowed.

Slide 3.3 – Key Takeaways: Termite and Ant Biology

- Termites vs Ants
 - Wings
 - Termites have four wings of about equal length and the wings are nearly twice as long as the body
 - Ant wings are only a little longer than the body and the hind pair is much shorter than the front pair
 - Waist
 - Termites do not have a pinched or narrow waist
 - Ants have a pinched waist

- Antennae
 - Termite antennae are straight and beadlike
 - Ant antennae are elbowed

Slide 3.4 – Termite Biology

- Gradual Metamorphosis: egg, nymph, adult
- Do not have a true larval or pupal stage
- Broader ‘waist’ compared to the pinched waist of ants
- Straight antennae with uniform segments
- Colony is composed of workers, soldiers, reproductives, kings and queens
- Colony is composed of workers, soldiers, reproductives, Kings and Queens

Slide 3.5 – Termite Biology

- Soldiers
 - Soldiers are sterile and most of them lack wings and eyes as well.
 - Soldiers are the fighters and defenders of the colonies with their large mandibles.
- Alates
 - Alates are responsible for founding new termite colonies, these are considered swarmers.
 - During swarming season alates emerge in large numbers at approximately the same time to enhance their probability of finding mates from different colonies.
 - Swarming flights are of interest to both pest managers and their customers because they act as a warning that termites are active and present.
- Queens and Kings
 - The queen and King are the main reproductive individuals within a colony.
 - Once there are enough workers to support the queen her only job is to produce offspring.
 - A large queen may lay more than 1,000 eggs per day.
- Neotenics
 - Neotenics, workers that develop reproductive systems assist in laying eggs once the queen’s egg production decreases.
 - Neotenics will replace the queen once she dies or deteriorates.
- Feeding
 - Termites eat cellulose, a complex carbohydrate found in plant cell walls.
 - Termites harbor special microorganisms in their digestive tracts called symbiotic bacteria and protozoa which help break down cellulose into sugars that termites can digest as food.
 - The exchange of nutrition via regurgitation or anal secretion is called trophallaxis.
 - This enables workers to feed the larvae, nymphs, soldiers and reproductives within the colony.
 - Trophallaxis also makes it possible to manage termites colonies with toxic baits.

Slide 4.1 – Dampwood Termites and Additional Pest Intro

Slide 4.2 – Dampwood Termites

- They do not require contact with damp ground
- They require wood with high moisture content
- Once a colony is established they can extend habitat to slightly drier wood
- Normally not a major concern on installations because the wood must be exposed to high moisture
- Like dry wood termites, dampwood termites build nests within the wood they attack

Slide 4.3 – Wood Destroying Beetles

- Powder Post Beetle
 - Powder post beetles derive their name from their ability to reduce wood to finely powdered frass
 - Larval stages of these beetles are very similar, so accurate identification is difficult
 - Generally, they are white and yellow, soft bodied and hairy, with well-developed, five-jointed legs
 - They construct larval mines in wood and pack them tightly with frass
 - IMPORTANCE
 - Most powder post beetles can work in dry, well-seasoned wood, damaging finished products such as tool handles and gun stocks, joists, beams, floorings, and high-grade lumber in storage.
 - Powder post beetles may continue to work in the same wood until nothing is left but a thin outer shell that is filled with powdery frass.
 - Flecks of powdery dust collecting beneath infested timbers often reveal their activity.
 - The larvae of a single powder post beetle can cause considerable damage. Most species do not deposit eggs on wood after it has been seasoned; this limits the danger of infestation and total damage.
- True Powder Post Beetle
 - LYCTIDAE
 - Small - 1/12 to 1/5 inch long
 - Slender, slightly flattened or oval, and dark brown to black
 - Annually destroys thousands of dollars of seasoned lumber and wood products
 - Attack wood with a moisture content of 15% or less
 - The two most destructive species of Lyctus beetles are found in the eastern half of the United States (US)
 - Attacks sap of hardwoods such as hickory, pecan, oak, and walnut
 - Damage will be indicated by a presence of very fine sawdust and small holes (1/32" to 1/16") in wood
- False Powder Post Beetle
 - BOSTRICHIDAE
 - Large, 1/8 to 3/4 inch long and cylindrical
 - Head is directed downward and covered by a hood
 - Attacks both hardwoods and softwoods depending on the species

- Can be imported in lumber, veneer plywood, or furniture
 - Generally tunnel with the grain of the wood
 - Frass (feces) produced will be sticky with a hole 1/8" to 3/8" in diameter
 - The red-shouldered shot-hole borer, *Xylobiops basilaris*, is probably the most common bostrichid of the eastern United States
 - It attacks practically all freshly cut and partially seasoned hardwood, and frequently damages furniture and rustic work
- Death Watch Beetle
 - ANOBIIDAE
 - Small, 1/4 inch long
 - Dark brown spotted with patches of yellowish hairs
 - Create a distinct tapping or ticking sound to attract mates
 - This family includes a number of destructive species that may be selective or may attack both softwoods and hardwoods; the larvae can cause considerable damage.
 - The common furniture beetle, *Anobium punctatum*, is a small, elongated, sub-cylindrical, brown beetle that is about 1/8 inch long.
 - The deathwatch beetle, *Xestobium rufovillosum*, is an oblong, rather stout beetle that is ¼ inch long, dark brown, and spotted with patches of yellowish hairs.
- Brown Spider Beetle
 - PTINIDAE
 - The most widely known beetle in the family ptinidae is the brown spider beetle, *ptinus brunneus*
 - this beetle may occasionally damage pine boards in old buildings
 - The white-marked spider beetle, *Ptinus fur*, is 1/8 inch long, brown, oval, long-legged beetle that resembles a spider
 - It is often found in buildings and warehouses and generally feeds on dried vegetable or animal matter, but it has been found in pine and oak woodwork

Slide 4.4 – Carpenter Ants

- Carpenter ants are so named because they tunnel into wood and excavate galleries to make their colonies.
- They do not eat the wood; they excavate wood that has been damaged previously by mechanical action, fungi, or other insects.
- These ants are very large—¼ to ½ inch in length (6 to 10mm) and are yellowish brown, dark brown, black, or have a combination of both red and black body color.
- These ants feed on honeydew, a secretion they obtain from aphids, scale insects, or mealy bugs
- Carpenter ants are also predaceous on other insects
- They do not sting, but will bite readily when aggravated
- They may build nests in the dead heartwood of living trees, logs, house timbers, poles, or most any other wood material; they are most destructive in softwoods.

- Most of their tunnels are roughly parallel and run with the grain of the wood; other shorter tunnels cut across the grain connecting parallel tunnels within the wood and opening to the outside.
- Usually nest in moist wood, where they hollow out extensive galleries, causing rapid rotting.
- As a result, they may damage a variety of products, ranging from wooden fences, posts, deck/porch areas, and structural foundations but may become a nuisance inside base facilities.
- When their nest is indoors, there is usually a much larger nest in wood somewhere around the building exterior.
- If carpenter ants seriously damage structural wood, you should have it replaced.

Slide 4.5 – Carpenter Bees

- Carpenter bees belong to the genus *Xylocopa*
- They are large bees, sometimes an inch long
- Most species are found in the southern United States and in the tropics
- Carpenter bees, like carpenter ants, do not eat wood; they excavate tunnels parallel with the wood grain for nesting sites
- Unlike ants and some other bees, carpenter bees are not social insects with large colonies
- Tunnel openings are perfectly round, or nearly so and may extend as much as a foot and are divided into brood cells

Slide 5.1 – Wood Destroying Fungi Intro

Slide 5.2 – Wood Destroying Fungi

- CHARACTERISTICS
 - Wood-destroying fungi are living organisms; they are plants that do not have chlorophyll.
 - Without chlorophyll, they cannot use sunlight to produce food; therefore, they obtain their food from an organic source.
 - When ideal environmental conditions of humidity and temperature exist, a fungus spore will germinate by developing a hyphal tube or filament.
 - If only water and inorganic materials are present, fungal growth will stop after the spore uses up its own organic materials.
 - If proper nutrients are available, such as the cellulose in wood, the fungus continues to grow; hyphae begin to branch out and form parts, including the mycelial thallus and spore-bearing structures such as bracket fungi, toadstools, mushrooms, and puffballs.
- TYPES OF DAMAGE
 - Moisture damage/weathering
 - Precipitation or humidity variations cause wood to swell and shrink repeatedly
 - Paints and varnishes protect wood surface against extreme, rapid changes in moisture content
- FUNGAL CLASSIFICATION
 - MOLD FUNGI

- May discolor the wood, but they do not break down wood fiber
- Can indicate a moisture level in the wood high enough to also support the growth of wood decay fungi
- STAIN FUNGI
 - Shades of blues, browns, reds, and yellows
 - Blue stain most common
 - Can seriously damage cell walls and mechanically weaken the wood
- ROTS AND DECAY
 - White rot
 - Breaks down all major wood components
 - Causes rotted wood to feel moist, soft and spongy, or stringy and to appear white bleached
- BROWN ROT
 - Decays the cellulose and hemicelluloses in wood, leaving a brown residue of lignin, the substance which holds the cells together
 - Wood affected by brown rot is usually dry and fragile which easily crumbles into a powder
 - Generally more serious than white rot
- WATER-CONDUCTING FUNGI
 - Fungus that has specialized root-like water-conducting tubes, called rhizomorphs, which allow it to transport water from the soil to the wood
 - Can quickly spread through a building and destroy large areas of flooring and walls in as little as a year or two

Slide 6.1 – Structural Pest Survey Intro

Slide 6.2 – Wood Destroying Beetles

- Overview
 - Structural pests weaken and in severe cases can destroy structures.
 - It is imperative that surveys be done on a regular basis to identify any possible infestations or harborage areas that would make it susceptible for an infestation.
 - Much like stored product pests, structural pests are also considered “economic pests” because they have a direct impact on funding when we must replace wooden structures which they destroy by infestation.
 - IMPORTANCE
 - The DoD is concerned about these organisms because it has billions of dollars invested in wooden structures and wood products.
 - Wood is also an essential building material for constructing temporary and stationary structures during military build-ups and contingency operations.
- Principles
 - Although dry-wood termites destroy wood at a much slower rate than subterranean termites, termite damage to buildings follows predictable patterns, and if left unchecked, the damage usually becomes extensive.

- Damage patterns include areas around plumbing near cracked foundations, and this predictability may help simplify inspections and control measures.
- TUNNELING
 - In their search for new food sources, subterranean termites construct exploratory tunnels through the soil.
 - When these tunnels emerge above ground, workers usually cement them securely to solid objects, like foundation walls or pipes.
- Undisturbed, these tubes, which are made of earth and other materials, will continue upward until the workers find food.
- If solid objects block their path, termites will continue probing until they find or create a passage.
- Once they gain access to wood in a building, termites may continue their destructive feeding for several years before they are found.
- Attack Areas
 - In wooden frame buildings, the termite attack pattern varies, depending on the type of construction and associated environmental factors. If these buildings have wooden floors, damage may be most severe below the floor level, in sills, joists, and sub-flooring.
 - In wood frame buildings with concrete floors, the damage may first be evident in door or window frames or baseboards.
 - Nonetheless, there also may be more extensive hidden damage to studs, sheathing, and soleplates. In buildings built mainly of concrete and masonry, termite damage may be limited to such wooden items as door and window frames, baseboards, and insulating material composed of wood fibers. If termites emerge somewhere above the first floor in a frame structure, this normally indicates there is a large colony and major structural damage.
 - ADDITIONAL CONSIDERATIONS
 - Although it is unusual, a new building may be severely damaged by termites during its first few years.
 - This happens when wood debris (usually tree stumps and roots) that contains large, active colonies of termites is left in the soil at the building site.
 - Under these conditions, the extended pattern of damage is the same as that found in older buildings where control has been neglected.
- Inspection
 - Termite inspections are required annually for areas that are subject to termite infestations.
 - There are two reasons to conduct annual inspections:
 - They help you detect active or potential infestations.
 - They aid on-site planning for management procedures needed.
 - In regions that have moderate to heavy infestations, inspect all structures that are built wholly or partially of wood at least annually; inspect these structures more often if local conditions warrant.

- Conduct inspections every 2 to 3 years in regions where infestations are rare.
- During your inspection, identify any conditions conducive to future termite attack
- Give special attention to any structure that is located on moist soil, has a poor crawl space or ventilation, or is subject to water leaks.
- Give prompt attention to all complaints of “flying ants” which could indicate a termite emergence, and record all information available at the time of the complaint.
- Use Air Force Civil Engineer Center (AFCEC) Form 1070, Termite and Wood Decay Inspection, to record information on each structure where termite inspections are conducted.
- Procedures
 - Visual Inspection
 - Grab necessary equipment
 - Probe – used to investigate condition of wood
 - Flashlight – used to illuminate dark areas
 - Hard Hat – used to protect head from overhead obstructions during survey
 - Coveralls – used to protect technician during surveys
 - AFCEC Form 1070, Termite and Wood Decay Inspection
 - Search favorable areas or conditions where termites are known
 - Search for signs of active infestation:
 - Swarmers
 - Mud tubes
 - Discarded wings
 - Small holes in wood
 - Damaged wood
 - Use moisture meter to determine moisture levels in wood
 - Document and report any findings on the AFCEC Form 1070

Slide 6.3 – Inspections Menu

- Wood Destroying Fungi
- Signs of Carpenter Ant Infestation
- Other Wood Destroying Beetles

Slide 6.4 – Wood Destroying Fungi

- Perform a visual inspection for signs of an infestation.
- You should consider wood that is in storage and in use.
- WOOD IN STORAGE
 - Inspections should determine the extent of visible fungal infestations and excessive or changing moisture conditions.
 - Look for warping, twisting, checking, and splitting
 - Proper pile construction and yard sanitation are essential to prevent lumber deterioration.
 - If wood becomes wet and does not evenly dry the wood will warp over time.
- WOOD IN USE

- Qualified personnel should make inspections at least annually for wood decay in structures
- When you inspect wood in use, give special attention to places where moisture may be present, such as in crawl spaces, basements, window and door frames, and porch columns and railings.
- Do not overlook the fact that even heavy coats of paint may hide conditions of rot; use a sharp probe when inspecting painted wood.
- **ADDITIONAL CONSIDERATIONS**
 - Excess moisture areas (standing water near wood, over damp material)
 - Areas with limited sunlight (dense overgrowth/shaded areas)
 - Identify species present
 - Mold/Stain/Water Conducting Fungi
 - Rots (Brown/White)

Slide 6.5 – Other Wood Destroying Beetles

- Periodically inspect wood structures and products for damage by wood-destroying insects.
- Most times a customer reports damage to a piece of furniture or in severe cases the infrastructure of a facility.
 - Perform a visual inspection looking for signs of an infestation
 - Frass- excrement expelled from feeding insects
 - Kickholes – look for accumulated frass under small holes in wood
 - Identify species present
 - True powder post beetles – frass is fine with a dry texture
 - False powder post beetles – frass is coarse with a sticky texture

Slide 6.6 – Signs of Carpenter Ant Infestation

- Finding piles of wood shavings or sawdust looking material beneath wooden areas such as baseboards, door jambs and window sills.
- Finding large winged ants coming from the ceiling, floor joists, window sills or other cracks and crevices within a structure.
- Tunnels are roughly parallel and run with the grain of the wood.
- Nest in moist wood where they hollow out galleries causing signs of rapid rotting within a piece of wood.

Slide 7.1 – Structural Pest Control Measures Intro

Slide 7.2 – Structural Pest Control Measures Main Menu

- Termite Control
- Site Sanitation and Foundation Construction
- Ventilation Drainage Skirting and Miscellaneous Building Appendages
- Contingency Considerations

Slide 7.3 – Termite Control

- The best time to protect a structure from termite attack is during its planning and construction, although some preventive measures are applied after construction is completed.
- Air Force Manual (AFMAN) 32–1053, Integrated Pest Management Program, indicates Pest Management personnel shall work with Civil Engineer (CE) and other design agencies to ensure termite treatments are included in new construction and major renovation projects where required.
- When needed, use only non-repellent termiticides in accordance with Unified Facilities Guide Specification 31 31 16, Chemical Termite Control, applied at the highest Environmental Protection Agency (EPA)-labeled concentration and application rate.
- Follow design and construction recommendations and wood preservative applications without deviation—regardless of the urgency to complete construction by a specified date.
 - Common errors of design and construction:
 - Burying wood items (stumps, logs, boards, stakes, and form boards) beneath buildings or next to foundations
 - Improperly grading for drainage
 - Providing for insufficient air circulation and cross-ventilation
 - Failure to use chemically preserved wood

Slide 7.4 – Site Sanitation and Foundation Construction

- SITE SANITATION
 - Remove all surplus wood, including stumps, tree roots, logs, and other wood debris from the building site before construction begins.
 - Also remove all form lumber, grade-stakes, and wood scraps by the time construction work is complete.
- FOUNDATION CONSTRUCTION
 - Building foundations must be impervious to subterranean termites, and woodwork resting on the foundation should be protected against attack.
 - Poured concrete, reinforced to prevent cracks, with the expansion joints properly filled.
 - Masonry walls capped with at least 4 inches of reinforced concrete, or its equivalent.
 - Hollow blocks with all rows filled with concrete.
 - Wood posts, piers, steps, or braces pressure treated with an approved chemical preservative.
 - Ensure you provide adequate clearance between the wood and soil both inside and outside the building.

Slide 7.5 – Ventilation, Drainage, Skirting and Miscellaneous

- Adequate ventilation and drainage are needed to help prevent termite attack.
- Soil moisture, air movements, and humidity should determine the number and size of openings.

- Soil adjacent to foundation walls should be graded to let surface water drain away from the building.
- The minimum clearance for effective inspection is 18 inches from the ground to the bottom of lowest joist, beam, or girder.
- SKIRTING
 - When using skirting, you need a clearance of 3 to 6 inches between it and the ground.
 - If this space is closed in winter, reestablish it early each spring.
- MISC. BUILDING APPENDAGES
 - Install miscellaneous building appendages such as porches, steps, terraces, platforms, and fire escape ladders, with an unbridged clearance or effective barrier to prevent termite entry into buildings.
 - Wood in contact with the soil should be pressure-treated with approved wood preservatives.
- Use only treated wood for construction timbers placed on concrete or masonry foundations
- Pipes and conduits often give termites entry points.

Slide 7.6 – Contingency Considerations

- Harvester Termites:
 - Distinguished by the serrated inner edge of their mandibles, and their functional compound eyes which are present in all castes.
 - Forage for grass at night and during daylight hours, and the pigmented workers are often observed outside the nest.
 - Range includes the deserts and savannas of Africa, the Middle East, and Southwest Asia.

Slide 8.1 – Course Completion

Congratulations, you have completed the structural pest identification lesson. Please click complete lesson to receive credit.

3E453 – Pest Management Journeyman

Module 3, Lesson 6, Task 1 (10.10.1, 10.10.3, 10.10.4) Vertebrate

Slide 1.1 – Introductory Slide

Slide 1.2 – Lesson Title Slide

3E4X3 Career Development Course

10.10.1, 10.10.3, 10.10.4 Vertebrate

Slide 1.3 – Instructions

Welcome to the Vertebrate Pests lesson.

- Upon completion of this lesson, you must be able to successfully identify the relationship of basic facts and state general principles relating to identify, survey, and control measures for vertebrate pests with at least 75% accuracy.

Slide 1.4 – Overview

In this section, we will cover the following topics:

- Identification
- Survey
- Control

Slide 2.1 – Identification Intro

Slide 2.2 – Identification: Common Vertebrate Pests

- Vertebrate pests such as rodents, bats, birds, and wild animals are a common concern regarding military operations and can serve as hosts for certain insects and mites

Slide 2.3 – Identification: Common Vertebrate Pests Menu

- Rodents
- Feral/Stray Animals
- Lagomorphs and Bats
- Field Rodents
- Common Wild Animals

Slide 2.4 – Rodent Characteristics

- Overview
 - Effects of domestic rodents:
 - Contaminate large amounts of food each year

- Rodent management is important from both economic and medical standpoints
- Rodents are common hosts of ectoparasites like fleas, ticks and mites which can serve as vectors or disease-causing pathogens.
- Oriental rat flea is infamous for its ability to transmit the bacterium that causes bubonic plague from rodents to humans and is the likely vector that caused death to millions of people in Europe and the Middle East during the great plagues of the middle ages.
- Plague, Murine typhus, rat bites, hantavirus, and Rickettsialpox, spread salmonella food poisoning.
- They chew electrical wiring to grind down their teeth, causing electrical failure and/or fire hazards
- Characteristics
 - The most common and problematic of domestic rodents are:
 - Norway rat
 - Roof rat
 - House mouse
 - NORWAY RAT
 - Largest of the domestic rodents
 - Up to 17 ounces
 - Can reach up to 19 inches in length
 - Brown to black with grayish to yellow-white belly
 - Thick heavy body with a round (blunt) nose
 - Digs burrows in the ground outdoors 6-8 inches below ground; indoors in wall voids and under floors
 - Tail: shorter than head and body
 - Opening required for adults to enter a building: 1/2 inch
 - Typical range: 100-450 feet from nest
 - Water requirements: 1-2 ounces per day
 - Droppings: 3/4 inch long and blunt ends
 - Associated diseases and pathogens
 - Rat-bite fever, salmonellosis, murine typhus, listeriosis, trichinosis
 - ROOF RAT
 - Up to 12 ounces
 - Slightly over 19 inches long due to a long tail which is longer than head and body combined
 - Body is slender and varies in color from black to light brown
 - Muzzle is pointed, with large ears
 - Builds its nest above ground, in hollow trees, vines, rafters, attics, rafters and wall voids
 - Opening required for adult animals to enter building: 1/2 inch

- Typical range: 300 feet from nest
 - Water requirements: 1-2 ounces per day
 - Droppings: 1/2 inch long and has pointed ends
 - Associated diseases or pathogens:
 - Rat-bite fever, salmonellosis, murine typhus, listeriosis, trichinosis
- Common Rat
 - BIRTH AND DEVELOPMENT
 - Born on an average 22 days after mating
 - Large litters, many die during birth
 - Babies stay with the mother for a period of time to learn
 - They learn by association by imitating their mother
 - By 3 months old they are completely independent from their mother
 - SOCIAL BEHAVIOR
 - Social animals and live in colonies with well-defined territories they mark with urine
 - Dominant male leader
 - Aggressive
 - RAT SENSES
 - Poor vision, nearly color blind, 30-45 feet is the limit of their vision
 - Sensitive nose to locate food, follow pathways, tell whether friend or foe, and identify new objects
 - Long whiskers and guard hairs to touch their way through dark burrows, wall voids, and other runways
 - Ears detect faint sounds that signal danger
 - Neophobia - fear of new objects
 - FEEDING HABITS
 - Omnivorous (eats both vegetable and animal substance)
 - Drink about 1/2 to 1 ounce of water per day
 - Steady eaters, and will usually take food to a safe place to eat if possible
 - RANGE
 - Begin foraging just after dark
 - Travel 100 to 150 feet from their nest
 - DENS
 - Norway - dig burrows in ground
 - Roof - builds its nest above ground in attics, trees, etc.
- Mouse
 - HOUSE MOUSE CHARACTERISTICS
 - About 3 1/2 inches long
 - Head and feet in proportion to its body
 - Ears are moderately large and distinct
 - Dusky gray to dark gray with their belly slightly lighter cream color

- Tail is semi-naked and about the length of the head and body combined
 - Weighs 1/2 to 1 ounce
 - Opening required for adult animal to enter a building: 1/4 inch
 - Typical range: usually 10-12 feet from nest
 - Water requirements: requires very little to no water
 - Builds nests in appliances and wall voids
 - Droppings: 1/8 – 1/4 inch long and pointed
- DEER MOUSE CHARACTERISTICS
 - Bi-colored - upper portion of the body and tail is medium to dark brown and the underside of the tail, feet and stomach are white
 - Body is 2 3/4 to 4 inches long and the tail is 2 to five inches long
 - The eyes and ears of the deer mouse are slightly larger than the house mouse
 - Opening required for adult animal to enter a building:
 - 1/4 inch
 - Typical range: larger than the house mouse and will forage outdoors for food; 1 to 3 acres
 - Builds nests in hollow logs or tree stumps, under logs, stones and sheds and other structures in or near wooded areas
 - Droppings: 1/8 to 1/4 inch long and pointed
- MOUSE GENERAL INFORMATION
 - Prolific breeders
 - Average litter size is six
 - One litter every 50 days is possible
 - Life expectancy is about 1 year
- Social behavior
 - Dominant male
 - Active at night
 - Travel entire territory daily
 - Very aggressive
 - Dart from place to place, covering the same route over and over again
- MOUSE SENSE
 - Color blind and poor vision
 - Rely on smell, taste, touch, and hearing
 - Keen sense of smell and taste
 - Sense of touch same as rats
 - Excellent sense of balance
- CURIOSITY
 - Do not fear new objects
 - Will investigate changed territory thoroughly
- FEEDING HABITS
 - Eat the same kinds of foods as humans

- Includes: meats, grains, cereals, seeds, fruits, and vegetables
- Prefers sweet liquids rather than water
- Feed about 15 to 20 times per day
- They nibble each time they feed
- RANGE
 - Seldom more than 30 feet
- PHYSICAL ABILITIES
 - Excellent jumpers, jumping 12" high from floor to elevated surface
 - Run horizontally along insulated electrical wires, small ropes with ease
 - Can run up almost any vertical surface if the surface is rough
 - Capable of squeezing through an opening slightly larger than 1/4" in diameter
 - Can survive and thrive cold storage facilities at 14° F
 - Capable of falling from a height of 8 feet (') to the floor without injury
 - Capable swimmers, although they generally do not take to water
 - Can walk or run along ledges too narrow for rats

Slide 2.5 – Field Rodent Identification

- Ground Squirrels
 - The ground squirrel is included in the same family as:
 - Chipmunks
 - Prairie dogs
 - Other ground-dwelling squirrels
 - Ground squirrels are diurnal (active during the day) and spend most of their time above ground feeding on low lying vegetation
 - They are typically 9 to 19 inches long, weigh approximately 8 to 14 ounces when full grown, and are gray to reddish-brown in color
 - Most species of ground squirrels have large ears, a rather long and narrow skull, well-developed cheek pouches, and long hairy tails
- Tree Squirrels
 - Tree squirrels may be divided into three groups:
 - Large tree squirrels (gray fox and tassel-eared)
 - Pine squirrels (red and Douglas)
 - Flying squirrels (northern and southern)
 - Most common squirrel found throughout the United States and often invades buildings is the "gray squirrel"
 - Length of head and body is 8" to 10" long and the tail is 8" to 10" long
 - Usually gray on back and sides with a whitish underside
 - Large, bushy tail
- Pocket Gophers
 - Diurnal (active during the day)
 - Live aboveground, feeding on low-lying vegetation
 - Head and body, 5 1/2" to 9" long with a tail of 2" to 4 1/2" long
 - Chunky body and a short tail

- Front limbs are strong and carry long claws which are used for digging and fighting
- Relatively large incisors (front teeth) used for the same purpose
- Lips close around and behind the teeth so it will not eat dirt
- Light to dark brown
- Chins and bellies are almost white
- External cheek pouches
- Certain species run backwards through their burrows using their tail as a guide
- Prairie Dogs
 - Relatively large incisors (front teeth) used for the same purpose
 - Lips close around and behind the teeth so it will not eat dirt
 - Light to dark brown
 - Chins and bellies are almost white
 - External cheek pouches
 - Certain species run backwards through their burrows using their tail as a guide
 - Dig deep burrows and may be dormant for short periods during cold weather
 - Populations may vary from 5 to 35 per acre and individuals can live as long as 8 years under ideal conditions
 - The major medical concern with prairie dogs with relation to military operations is their role as reservoirs of plague and tularemia
 - This can be a major problem if their towns are located in training areas where plague is endemic
- Moles
 - APPEARANCE
 - Most common pest moles in North America are in the genus "Scalopus"
 - Small, gray, furry, about 5 inches in length, have a long tapering snout, lack external ears, and have tiny, barely detectable eyes
 - Toes on their feet are slightly webbed
 - Have a short, naked tail
 - HABITAT
 - Live in woods, fields, lawns, and gardens
 - Moles build a nest burrow and several main tunnels branching off it that can be deep underground

Slide 2.6 – Common Wild Animals

- Coyotes
 - Brownish gray with light gray to cream-colored belly; most have dark or black guard hairs over their back and tail; and weighs 22 to 45 pounds
 - Exist everywhere; most active at night and during early morning hours
 - Carry numerous parasites and diseases (Rabies)
 - Prey on pets, they are a threat to public health and safety when they frequent airport runways and residential areas
- Skunks

- Have a triangular-shaped head and a moderately elongated body with short, muscular legs and long, sharp non-retractable claws
- About the size of a large house cat
- Fur is mostly black with white on top of the head and neck that extends down the back, usually separating into two white stripes
- Raccoons
 - Shaggy grayish brown fur
 - Black "bandit" face mask
 - Black and white ringed tail
 - Stocky mammal about 2 to 3 feet long and weighs 7 to 30 pounds
- Opossum
 - White or gray with under fur that is dense with sparse guard hairs; round, hairless ears; face is long and pointed
 - Weighs as much as 14 pounds, with a rat-like tail
 - Nocturnal, venturing out shortly after dark
 - Not usually carriers of rabies; their body temperature is considered too low for the rabies virus to survive
 - Eat insect pests

Slide 2.7 – Lagomorphs and Bats

- Lagomorphs Overview
 - Mammal of the order Lagomorpha; most commonly hares or rabbits
 - Brownish gray with light gray to cream-colored belly; most have dark or black guard hairs over their back and tail; and weigh 22 to 45 pounds
 - Exist everywhere; most active at night and during early morning hours
- Hares / Jackrabbits
 - WHITETAIL HARE
 - Largest, 18-22 inches, weighs 5-10 pounds
 - Brownish gray in summer; white or pale gray in winter
 - BLACKTAIL HARE
 - 17-21" long, weigh 3-7 pounds
 - Grayish brown, large black-tipped ears, black streak on top of tail
 - SNOWSHOE HARE
 - 13-18" long, weighs 2-4 pounds; feet are larger than jackrabbits and ears smaller
 - Turns white in winter and dark brown in summer
 - EUROPEAN HARE
 - Head and body length can range from 19 to 30 inches, weighs 8 pounds, and has a tail length of 2.8 to 5.1 inches
 - Reddish brown in the summer and the sides of the head and base of the ears turn white in the winter
 - Largest living lagomorph
- Bats
 - Only true flying mammal, considered beneficial

- Associated with rabies and histoplasmosis
- Forelimbs form webbed wings
- Have very sharp teeth to bite through the hardened armor of insects or the skin of fruit
- Roughly 40 known species found throughout the United States (US)
- Bats are capable of transmitting disease-causing pathogens, such as rabies and fungal pathogens

Slide 2.8 – Feral/Stray Animals

- Cats
 - Feral cats can be any variety of common domestic cats or mixed breed
 - Transmit diseases, damage buildings, contaminate food supplies, and kill birds and other wildlife
- Dogs
 - Feral/stray dogs are known as "wild or free-ranging"
 - The key difference between domesticated dogs and feral/stray dogs is their behavior towards humans. This behavior includes:
 - Growling, barking, snarling, and taking bites
 - They do not show fear towards humans and may attack when encountered without provocation
 - Some have been known to eat their victims, particularly small children
 - Their territorial range may extend up to 50 miles
 - They are known spreaders of many canine diseases, including rabies
 - Some have been known to interbreed with foxes, coyotes, and wolves, with their offspring displaying hybrid characteristics of both species

Slide 3.1 – Vertebrate Pests Survey Intro

Slide 3.2 – Survey Principles Menu

- Overview
- Domestic Rodents
- Squirrels, Rabbits, Hares, & Prairie Dogs
- Pocket Gophers
- Moles
- Feral/Stray Animals
- Common Wild Animals
- Bats

Slide 3.3 – Overview

- Vertebrate pests such as rodents, bats, birds and wild animals are a common concern regarding military operations and can serve as hosts for certain insects and mites. Surveys and monitoring pest populations are a must in any Pest Management program. Regular monitoring is key to a successful integrated pest management (IPM) program and ensuring pest thresholds do not get out of control.
- Weather, temperature, sanitation, and infrastructure will all play a role in how well a pest can thrive or not; as pest managers you must ensure you take an active role to

inspect and survey activity levels and potential threat areas. It is important that you familiarize yourself with each pest's survey and control methods.

- Consult with your Natural Resource Program Manager, Major Command (MAJCOM) Pest Management Consultant, and local or host nation wildlife officials before conducting controls to ensure that they are not an endangered species and protected by law. Once you have completed your survey and determined that an action threshold has been reached, you will then need to determine control measures.

Slide 3.4 – Domestic Rodent

- Before starting management actions against a rat or mouse infestation, first determine whether rats or mice are present, the species involved, the size of the rodent population, and where most rodent activity occurs. Things to look for are fresh droppings, runways, rub marks, tracks, gnawing, burrows and nests.
- DROPPINGS
 - Rat feces vary from 1/2 inch long by 1/16 inch in diameter to 3/4 inch long by 1/4 inch in diameter
 - House mouse droppings are very small, about 1/4 inch long and pointed at both ends
 - Pest Managers should notice the age of the droppings to determine if a building is currently infested
 - Fresh droppings are soft enough to press out of shape and usually look shiny and moist
 - Color varies, but it is normally black or nearly black
 - Within 3 to 4 days, depending on weather conditions, droppings become dry and hard
 - The quantity and size of droppings in an area may give an indication of the number of animals present
 - Fresh droppings are soft enough to press out of shape and usually look shiny and moist
 - Color varies, but it is normally black or nearly black
 - Within 3 to 4 days, depending on weather conditions, droppings become dry and hard
 - The quantity and size of droppings in an area may give an indication of the number of animals present
- RUNWAYS & RUB MARKS
 - Runways used by rodents often have rub marks which are greasy deposits left by the rodents' bodies as they rub against a wall, climb a pipe, or pass-through holes
 - These are often called "swing" marks when roof rats make them under rafters
 - House mouse runways may be anywhere and are the most difficult to find because of their small size and faint outlines
 - Fresh rub marks are soft when scratched, but old marks are brittle and will flake off
- TRACKS

- To easily see tracks, lay a flashlight down on its side
- Rat tracks are large, and the hind foot may be up to 1 1/2 inches long
- Mouse prints are considerably smaller, rarely even 1/2-inch long
- To determine the age of a rat or mouse run, notice its appearance
- A heavily used run will be hard-packed, shiny, and free of litter. Outdoor tracks are usually fresh, as weathering will quickly erase them
- The age of indoor tracks is hard to determine, and such tracks are best observed by using tracking powders
- Tracing rat and mouse runs may reveal the harborage, food, water supply, and means of entry into buildings, greatly aiding control measures
- **GNAWINGS**
 - Signs of rodent gnawings are among the best indications of a rodent population, if the gnawings are fresh
 - A newly gnawed wood surface has a fresh, light-colored appearance
 - The edges of freshly gnawed pieces of wood will have sharp edges and show individual tooth marks
 - Rats will smooth and enlarge holes they pass through; therefore, a smooth hole shows it is an old and much traveled route
- **BURROWS**
 - Rodent burrows have two main uses:
 - Nesting/hiding places
 - Routes of entry to a structure
 - Nesting and hiding burrows are usually 12 to 18 inches deep and may extend several feet in a horizontal direction
 - They often connect with other burrows
 - To gain entrance to buildings, rats may burrow up to 4 feet vertically to pass under a foundation wall
 - Norway rats prefer to live in the ground, and their burrows are easy to find and identify
- **OTHER SIGNS**
 - Occasionally, it is possible to use urine stains, rodent hairs, and other signs in rodent surveys
 - You can detect urine stains with an ultraviolet light, although other materials will also fluoresce under ultraviolet illumination
 - Evidence such as stains must be supported by other fresh signs of rodent infestation

Slide 3.5 – Squirrels, Rabbits, Hares, and Prairie Dogs

- **SQUIRRELS, RABBITS, AND HARES**
 - Typically, when any of these pests become a nuisance, a customer will call with the complaint
 - Trapping is the best means to survey and determine specific species present and the extent of the populace
- **PRAIRIE DOGS**

- Unlike moles, gophers and prairie dogs can be more than just a nuisance
- Surveying for prairie dogs requires a simple visual inspection of the infested area
- Coordinate all prairie dog controls with your Natural Resource Program Manager, MAJCOM Pest Management Consultant, and local wildlife officials

Slide 3.6 – Moles

- There are no special survey methods for moles
- Their presence is evident from their digging
- The only way to take a population survey is to watch them
- If an opening is made in a runway, the mole will repair it the next time it comes that way
- Information can be gained by checking, at short intervals through the day, small breaks made in several runs
- Moles work at all times of the day and night, especially in seasons when there is little variation in temperature

Slide 3.7 – Pocket Gophers

- They consume vegetation and their burrowing leaves holes in the ground
- Gopher mounds are fan or kidney shaped, which differentiates them from mole hills, which are round
- The mounds can be up to a foot tall, and about a foot to two feet in diameter
- There will be no surface tunnels connecting the mounds, like with moles
- Mounds are at the end of lateral tunnels that extend out from the main runways, and are plugged with soil to keep intruders out
- Gophers are solitary, but their tunnel systems can be very extensive, even covering an acre underground
- Tunnels can be a couple inches under the turf, or several feet deep in the soil, depending on the soil, available plants, and terrain

Slide 3.8 – Common Wild Animals

- Always contact local wildlife agencies for advice and assistance for any type of wild animal problems
- Coyotes, skunks, raccoons, opossum, & lagomorphs
- Most times these are all called in by customers
- Trapping is the most practical way to survey and control

Slide 3.9 – Feral/Stray Animals

- Cats
 - Feral
 - Usually clean, more so if neutered
 - Appears generally well-groomed
 - Muscular body; may appear well-fed
 - Can live alone or as part of a colony of feral cats
 - Fearful or aggressive around people
 - Negative body language – tail down, avoids eye contact
 - Silent around humans
 - Not microchipped

- May have their ear tipped, to show they have been neutered and returned to the site
- Stray
 - Likely to look dirty
 - Disheveled coat
 - Skinny body
 - Probably lives alone
 - May be friendly towards people
 - Positive body language – tail up, makes eye contact, may want petting
 - Meows or purrs around humans
 - Could be microchipped
- Dogs
 - Colors, body size, and weight range based on the key breeds involved

Slide 3.10 – Bats

- ROOSTING SITES
 - Bats normally roost in natural shelters, such as caves and tree cavities or under overhanging rocks, but can easily adapt to living in buildings where they roost in attics, hollow walls, chimneys, and similar places
 - A few species live as individuals, but most congregate in large colonies so infestations are frequently severe
- ACTIVITIES
 - Bats roost in an upside-down position and do not build nests
 - Droppings and urine deposits under roosting areas have a strong ammonia-like odor which usually serves to attract new bats to the roosting area, even after removing the original infestation
 - Bats are active during the evening hours and leave the roost at dusk in search of night-flying insects which provide their food
 - Although the eyes are quite small and their vision is poor, their hearing is acute
 - Bats navigate by means of a sonar-like echo location system which helps them readily avoid objects even in total darkness

Slide 4.1 – Vertebrate Pests Control Intro

Slide 4.2 – Survey Principles Menu

- Overview
- Domestic Rodent: Non-Mechanical
- Domestic Rodent: Proofing
- Rodent: Trapping

Slide 4.3 – Overview

- Due to vertebrate pests being hosts to many arthropod parasites and the pathogens they can carry; it is important to effectively control these pests. Not only can these pests have adverse effects on people and their well-being, but they can also interrupt the military mission if not under control. It is noteworthy that anytime you are handling live

animals such as rodents, bats, skunks, opossums, and raccoons you should always consult your local natural resources office and local wildlife control agencies to ensure the proper care and/ or removal procedures.

Slide 4.4 – Domestic Rodent Control: Proofing

- Mice can squeeze through an opening as small as ¼ inch; all holes should be sealed especially around pipes and conduits
- The first exclusion technique is to seal cracks and holes in the building
- Block openings around water and sewer pipes, electric lines, air vents, and telephone wires
- Screen air vents
- Caulk and seal doors
- Fit windows and screens tightly
- Repair breaks in foundation below ground level
- Repair gnaw holes or stuff with copper wool
- In areas where rodents must be eliminated, doors and windows should be made of, or covered with, metal
- Openings can be closed using sheet metal of at least 26-gauge, 1/4 or 1/2 inch hardware cloth, and cement; however, 1/2-inch hardware cloth has little value against house mice
- All holes in a building exterior should be sealed
- Rats can gnaw away wooden doors and windows in a very short time to gain entrance
- They can enlarge openings in masonry, especially if the mortar or brick is of poor quality
- Double walls and space between walls should be blocked with fire stops; these stops, as well as the beams supporting floors, should be constructed so they cannot be used as rodent runways

Slide 4.5 – Domestic Rodent Control: Non-Chemical Control

- SANITATION
 - Sanitation is the first element in any rodent prevention program, and it is the only measure that ensures long-term rodent suppression
 - Without sanitary maintenance, rodent populations will continue to recover to their original—or even larger—level once poisoning and trapping programs
 - Always note and report any sanitation problems encountered
 - For rodent management, sanitation involves proper storage of edible materials and disposal of all garbage and rubbish in rodent-proof containers
 - Even in a rodent poisoning program, sanitation plays a major role

Slide 4.6 – Rodent: Trapping

- MULTI-CATCH LIVE TRAPS
 - Identify location of rodent activity
 - Ensure entrance hole of multiple-catch is parallel to the wall
- SNAP TRAPS
 - Identify location where traps are to be set
 - Bait traps with a suitable material
 - Peanut butter works well for rats and mice

- It's sticky and harder to remove without triggering the trap
- Despite every cartoon you've ever seen, cheese is a bad choice, especially a large chunk of it
 - Easy for the mouse/rat to remove from the trap without being caught
- A variety of baits should be applied to find an effective choice
- Despite every cartoon you've ever seen, cheese is a bad choice, especially a large chunk of it
- Easy for the mouse/rat to remove from the trap without being caught
- A variety of baits should be applied to find an effective choice

Slide 5.1 – Course Completion

Congratulations, you have completed the vertebrate pests lesson. Please click complete lesson to receive credit.

3E453 – Pest Management Journeyman

Module 3, Lesson 7, Task 1 (10.11.1, 10.11.2, 10.11.3) Bird Pests, Identify, Survey & Control Measures

Slide 1.1 – Introductory Slide

Slide 1.2 – Lesson Title Slide

3E4X3 Career Development Course

10.11.1, 10.11.2, 10.11.3 Bird Pests, Identify, Survey & Control Measures

Slide 1.3 – Instructions

Welcome to the Bird Pests, Identify, Survey and Control Measures lesson.

Upon completion of this lesson you must be able to identify basic facts and principles relating to bird pests, identify, survey and control measures with at least 75% accuracy.

Slide 1.4 – Overview

In this section, we will cover the following topics:

- Bird Pest Identification Overview
- Description and Habits
- Survey Methods General Information
- Survey Procedures
- Structural Procedures
- Control Measures General Information
- Repellents
- Traps
- Lethal Controls

Slide 2.1 – Bird Pests Overview, Aerospace Mission Impact, Facility Impact Intro

Slide 2.2 – Bird Pests Overview, Aerospace Mission Impact, Facility Impact Menu

- Overview
- Aerospace Impact
- Facility Impact

Slide 3.1 – Bird Pests - Overview

- Both wild and domestic birds provide recreation and food for people.

- They eat insect pests of crops, lawns, and trees, and often they feed on weed seeds, thus preventing the growth of such pest vegetation.
- As scavengers and carrion feeders, they remove both natural and man-made refuse.
- They also attack snakes and rodents, helping to control these pests.
- As human activities have expanded over the years, people have routinely displaced birds from their habitats, and we have discovered that under some circumstances birds are a detriment to our well-being.
- For example:
 - Birds can be reservoirs of diseases and arthropod pests that attack people
 - They also can be dirty and noisy; they can contaminate food and ruin precision equipment
 - On military installations, birds are a problem especially around airstrips, where flocks may interrupt, damage, or destroy aircraft and injure or kill pilots and passengers
 - Birds can damage our food, dwellings and equipment and can become very expensive to fix or restore capabilities.

Slide 4.1 – Bird Pests – Aerospace Mission Impact

- Birds may save trees or plants from injuries caused by arthropod pests, but they can cause damage to vegetation with their roosting and nesting.
- When bird flocks inhabit structures, they cause fecal contamination of walkways, roads, or vehicles, and become a source of disease for people living and working around them.
- They are hosts to ectoparasites, such as fleas, mites, ticks, and other “bugs” that bite people.
- Aerospace Mission Impact
 - Although birds inspired human flight, birds and people now are often in conflict for airspace. By the time World War II started, bird hazards to aircraft were well-documented.
 - Semiannual bird migrations affect flying safety.
 - Local roosts may be occupied periodically or vacated throughout the breeding season.
 - As cold weather approaches, many species move southward, and there is increased potential for engine failure and fatal crashes because birds are easily sucked into the jet engines.

Slide 5.1 – Bird Pests – Aerospace Mission Impact

- Facility Impact:
 - The birds most often encountered as pests on military installations in the United States include pigeons, grackles, starlings, cowbirds, English sparrows, and various species of gulls
 - When roosting on or near buildings, these birds can become a noise nuisance
 - Parasites and many other pests common to bird nests routinely enter buildings and annoy people
 - In aircraft hangars and maintenance areas, bird droppings quickly corrode engine parts, electronic equipment, and airframe surfaces

- Because of laws that protect some species, never try to manage birds at your base without first consulting with the Major Command (MAJCOM) Pest Management Consultant

Slide 6.1 – Description & Habits Intro

Slide 6.2 – Description & Habits Menu

- Pigeon
- European Starling
- Turkey Vulture
- English Sparrow
- American Kestrel
- Miscellaneous Species

Slide 7.1 – Pigeons

- Descriptions
 - Common pigeons or rock doves (*Columba livia*) are well known to any city dweller.
 - Their droppings deface buildings and create sanitation problems, and the acid in these droppings causes premature rusting and corrosion on exterior parts of buildings, such as roof flashings and gutters.
 - Their nests may also clog gutters and rainspouts. Occasionally, large numbers of doves or pigeons appear in rural areas, especially around feed mills and cattle or hog farms.
 - Pigeons of North America vary in color and size:
 - Roughly 13 inches (") long
 - Color varies from snow white to brownish-red, or even multi-colored
 - Most common color is blue or ash gray with a white rump
 - Dark terminal band on tail and two dark crossbars on each wing
 - Usually iridescent (brilliant) green and violet area on neck
- Habits
 - These bird pests are a stocky/robust bird with a fanlike tail
 - Common color patterns are gray, black, white, and brown
 - In cities, pigeons move in flocks that may include several hundred birds that feed and roost together
 - Each female lays one or two eggs, which hatch in 17 to 22 days
 - The young reach maturity in about 4 weeks, but before this time elapses, the female has laid more eggs, thus keeping up an almost continual breeding cycle
- Impact
 - The close association of pigeons with people presents a potentially serious epidemiological problem since these birds harbor many diseases
 - Histoplasmosis, a systemic fungal disease, is probably the most common of these diseases
 - This is a respiratory disease that generally resembles a severe cold; however, it often produces lesions on the lungs that are like those caused by tuberculosis

- In acute cases, the patients develop a high fever, and the liver and spleen become enlarged; however, this disease is seldom fatal
- The direct cause of histoplasmosis is a fungus that frequently is found in soil that has been contaminated with pigeon droppings. People are infected when the contaminated dirt is disturbed, and they inhale or swallow airborne spores of the fungus.
- Probably the most publicized bird-transmitted disease is psittacosis (ornithosis, parrot fever), which is very often confused with viral pneumonia.
- A common source of human infection is inhaling dust particles from bird droppings, feathers, bird bodies, and nasal secretions
- People with this disease commonly develop chills, high fever, sore throat, a dry cough, and severe chest pains
- The human fatality rate for people contracting this disease is usually less than 1 percent

Slide 8.1 – European Starling

- Descriptions
 - These birds normally spend the summer months in suburban or rural areas, but when it turns cold in the fall, they will flock into towns and cities at night to seek the warmth and shelter of larger buildings, or to roost on trees in residential areas and city parks.
 - Starlings have winter and summer roosting phases
 - During the day they fly back to the country to find food, then at night return to the city again
 - 7 ½" to 8 ½" long
 - These birds are stocky and short-tailed, and have a seasonal color change
 - Spring/summer:
 - Have a green-purple plumage with bright yellow bill (beak)
 - Fall/winter:
 - Heavily speckled with white and have a dark bill
 - Starling eggs are pale blue, and there are three to six eggs per clutch
 - Twelve days are usually required for incubation and the young stay in the nest 2 to 3 weeks
- Habits
 - Two broods are usually raised each year
 - Starlings are quite hardy and are able to survive under difficult environmental conditions
 - European starlings (*Sturnus vulgaris*) are pests in cities and rural areas, traveling in large flocks that sometimes contain a million or more birds
 - In rural areas, starlings nest in tree cavities and on ledges around farm buildings; they are usually bothersome around grain elevators, corn fields, fruit trees and in cattle and hog feeding lots

Slide 9.1 – English Sparrow

- Descriptions

- Five to six eggs are laid per brood, and three to four broods are hatched each year
- Importance
 - English sparrows are small birds commonly seen in flocks; they are very active and argumentative
 - Even in small numbers, they frequently drive small songbirds out of an area
 - They are pests in gardens and orchards, and around buildings where they nest
- Habits
 - English Sparrow nests are normally built in, on, or near buildings
 - Nests are composed of twigs, grass, paper, and other materials; and they are built in gutters on roofs under eaves, and inside buildings on roof supports
- Impact
 - Two broods are usually raised each year
 - Starlings are quite hardy and are able to survive under difficult environmental conditions
 - Importance
 - European starlings (*Sturnus vulgaris*) are pests in cities and rural areas, traveling in large flocks that sometimes contain a million or more birds
 - In rural areas, starlings' nest in tree cavities and on ledges around farm buildings; they are usually bothersome around grain elevators, corn fields, and fruit trees and in cattle and hog feeding lots

Slide 10.1 – American Kestrel

- Description
 - North America's littlest falcon, the American kestrel, packs a predator's fierce intensity into its small body
 - It's one of the most colorful of all raptors
 - The male's slate-blue head and wings contrast elegantly with his rusty-red back and tail
 - The female has the same warm reddish on her wings, back, and tail
 - Hunting for insects and other small prey in open territory, kestrels perch on wires or poles, or hover facing into the wind, flapping and adjusting their long tails to stay in place
 - Females usually lay four to six eggs that are white with brown spots
 - Both the male and female help incubate the eggs
 - When the adults incubate the eggs, they sit on them to keep them at the perfect temperature
 - This is important for the healthy development of the young chicks inside
 - After about 29 days, the young kestrels hatch
- Habits

- While they are growing, the young eat about 2 to 3 times as much as the adults do, consuming 2 or 3 mice a day
- About 28 to 31 days after hatching the young are grown and ready to fly
- Impact
 - American kestrels occupy habitats ranging from deserts and grasslands to alpine meadows
 - You're most likely to see them perching on telephone wires along roadsides, in open country with short vegetation and few trees
 - Additionally, you are likely to encounter these birds on the flight line and they are major contributors in the bird air strike hazard (BASH) program
 - American kestrels have accounted for 881 strikes totaling \$2,611,273 in damage (fiscal years 1995–2013)

Slide 11.1 – Turkey Vulture

- Description
 - The most widespread vulture in North America, the turkey vulture is locally called a “buzzard” in many areas
 - A turkey vulture standing on the ground can, at a distance, resemble a wild turkey
 - When threatened, it defends itself by vomiting powerful stomach acids
 - They stand around 27 inches in length and have a wingspan up to 69 inches
 - It is black with brownish tones, especially on the feather edges
 - Legs are dark to pinkish in color, and the head is unfeathered
 - In the adult the red skin color of the head contrasts with the ivory bill and dark feather ruff on the neck
 - In the juvenile the skin of the head is dark, the bill dark with a pale base
- Habits
 - As a part of pair formation, several birds gather in a circle on the ground, and perform ritualized hopping movements around the perimeter of a circle with wings partly spread
 - In the air, one bird may closely follow another, the two birds flapping and diving
 - Nest sites are in sheltered areas, such as inside hollow trees or logs, in crevices in cliffs, under rocks, in caves, inside dense thickets, or in old buildings
 - When little or no nests are built; eggs are laid on debris or on the flat bottom of the nest site
 - Turkey vultures have accounted for 415 strikes totaling \$31,006,350 in damage (fiscal years 1995–2013)

Slide 12.1 – Miscellaneous Species

- Many other types of birds, such as woodpeckers, blue jays, swifts, martins, and grackles, can also be pests.
- No good general method of management has been developed for these birds.
- As best practice it is always best to contact the MAJCOM Pest Management Consultant, US Fish and Wildlife Service, county extension office, and/or host nation representatives to implement available, legal management methods to each situation encountered.

Slide 13.1 – Bird Pest Survey Methods Intro

Slide 13.2 – Purpose and Common Standards Video

- Video Closed Captions

Surveys are an important part of IPM for birds. Surveys must be conducted monthly during non-migration periods, and daily during migration periods. There are two types of bird surveys: Basic survey is accomplished in the birds' natural habitat, Structural Survey is accomplished in or around buildings where birds are living or causing problems.

Slide 13.3 – Takeaways

- Surveys must be conducted monthly during non-migration periods, and daily during migration periods
- There are two types of bird surveys:
 - Basic survey: Accomplished in the birds' natural habitat
 - Structural survey: Accomplished in or around buildings where birds are living or causing problems

Slide 13.4 – Bird Survey Procedures Menu

- Basic Survey Procedures
- Structural Survey Procedures

Slide 14.1 – Basic Survey Procedures Video

- Video Closed Captions

When conducting basic survey procedures, make sure to perform the following steps: Gather equipment such as binoculars, field guide, notebook and writing utensil. Then, locate birds and identify local and migratory bird species. After identifying birds, you should determine if a problem exists. Then, determine the location and time of the problem. Identify what birds are doing to cause problems (bird strikes, defecating on planes, or people). Lastly, determine what specifically is attracting the birds.

Slide 14.2 – Takeaways

- When conducting basic survey procedures, make sure to perform the following steps:
 - Gather equipment
 - Binoculars
 - Field guide
 - Notebook and writing utensil
- Locate birds
- Identify local and migratory bird species

Slide 15.1 – Structural Survey Procedures Video

- Video Closed Captions

When conducting structural survey procedures, make sure to perform the following steps: Identify facility with bird problem. Gather equipment such as: Coveralls, Gloves, Respirator, Notebook and Pencil. Identify birds. Determine what is attracting birds to the facility. Then, identify controls already in place. Determine why current controls are failing. Finally, determine new control methods.

Slide 15.2 – Takeaways

- When conducting structural survey procedures, make sure to perform the following steps:
 - Identify facility with bird problem
 - Gather Equipment
 - Coveralls
 - Gloves
 - Respirator
 - Notebook and pencil

Slide 16.1 – Bird Pest Control Measures Video

Slide 16.2 – Purpose and Common Standards Video

- Video Closed Captions

We mainly achieve pest bird population control through permanent and temporary management techniques. Permanent management is the more desirable method, and if economical and practical, it is the method of choice. Permanent management techniques can be successfully used against starlings, pigeons, and sparrows. Due to constant changing legal requirements on bird control, contact Natural Resource Program Management, MAJCOM Pest Management Consultant and local or host nation wildlife officials before starting a bird management program.

Slide 16.3 – Takeaways

- Bird pest population control is achieved through permanent and temporary management techniques
- Permanent management is the more desirable method
- Permanent management techniques can be used against starlings, pigeons, and sparrows
- Due to constant changing legal requirements on bird control, contact Natural Resource Program Manager, MAJCOM Pest Management Consultant and local or host nation wildlife officials before starting a bird management program

Slide 16.4 – Purpose and Common Standards Video

- Video Closed Captions

The most certain way to keep bird pests off a building is to construct the building so there are no roosting or nesting spaces on it. This requires cooperation between pest managers military engineers and architects when planning the building. Although it is usually impossible to make the entire building bird proof, the elimination of roosting, and or nesting sites during the design phase greatly reduces potential for bird problems on existing ornate buildings, or buildings with belfrys, towers overhanging ledges and so on birds can be effectively screened out with wire mesh that has openings not greater than 1 inch for pigeons, and 1/2 inch for sparrows and starlings. If buildings have openings that can now be closed completely the openings should be screened in in this manner. In Buildings with open sides screening can be dropped down from the edge of the roof to reduce size of the openings so it is still possible to use the building. Where ledges are no more than a few inches wide, wide metal such as sheet aluminum can be installed at a 45 degree angle to give a surface where birds cannot nest.

Slide 16.5 – Takeaways

- To keep bird pests off a building, construct the building so there are no roosting or nesting spaces on it
- Pest managers, military engineers, and architects are required to collaborate when planning the building
- Although it is usually impossible to make an entire building bird-proof; the elimination of roosting and/or nesting sites during the design phase greatly reduces potential for bird problems
- On existing ornate buildings or buildings with belfries, towers, overhanging ledges, birds can be effectively screened out with wire mesh that has openings not greater than 1 inch for pigeons and ½ inch for sparrows and starlings
- If buildings have openings that cannot be closed completely, the openings should be screened in this manner
- In buildings with open sides, screening can be dropped down from the edge of the roof to reduce the size of the opening so it is still possible to use the building
- Where ledges are not more than a few inches wide, light metal, such as sheet aluminum, can be installed at a 45 degree angle to give a surface where birds cannot nest

Slide 16.6 – Bird Pest Control on Airfields

- Discouraging birds from using airfields involves removing attractive habitat features.
- Grass height should be between 7 and 14 inches to discourage birds, controlling water drainage near airfields, along with several other methods need to be implemented to manage birds near airfields.
- For specifics on controlling birds on airfields refer to Air Force Pamphlet (AFPAM) 91–212, Bird/Wildlife Aircraft Strike Hazard (BASH) Management Techniques.

Slide 16.7 – Bird Pest Repellents

- There are numerous types of repellents that can be used against birds
- Depending on the birds being controlled, repellent controls can be either effective or ineffective
- Effective controls include audio devices, glues and gels, ammonia/misting, prepared baits; most of the ineffective controls are described under “scare devices”

Slide 16.8 – Bird Pest Repellents Menu

- Scare Devices
- Audio Devices
- Glues & Gels
- Ammonia/Water Misting
- Prepared Baits

Slide 16.9 – Scare Device

- AFPAM 91–212, outlines scare devices as ineffective in controlling birds; birds quickly habituate (get used to) these devices, and the problem remains unsolved
- Various scare devices include stuffed owls, balloons, rubber snakes, rotating lights, ultrasonic devices, and tinfoil streamers that flutter in the wind

- Many of these devices work for a short time where bird populations are not heavy, but when roosting or nesting space is at a premium, they are usually ineffective

Slide 16.10 – Audio Device

- Since birds are usually disturbed by sudden loud or unusual noises, many devices are designed to scare them off this way
- One such device is a small cannon, which uses acetylene gas to emit loud blasts at intervals
- Recorded distress calls are effective in limited situations, but have not been effective over large areas

Slide 16.11 – Ammonia/Water Misting

- A weak solution of ammonia and water can be used to discourage birds, particularly starlings
- A fine mist of the solution is blown into trees or onto buildings when birds are roosting and when the temperature is near or below freezing
- Applications for several nights are usually necessary to dislodge birds and treatments may be needed several times during a season

Slide 16.12 – Glues & Gels

- Various bird glues or gels also keep birds away from buildings. Many are made of thick tacky materials; some have a jelly-like consistency; others are thin enough to be sprayed.
- The lighter materials are more suitable for use on trees, although they can be used in many other situations. Heavy glues are usually applied with a putty knife or caulking gun.
- Application of bird glues or repellents to buildings is an effective way to discourage birds, they produce a “warm foot” sensation to birds, resulting in birds to roost elsewhere, but these repellents have some disadvantages.
 - Where they are visible, they deface buildings, and on window ledges they are a hazard to window cleaners
 - Also, their effectiveness is quickly reduced in dirty, dusty areas
 - Pigeons and starlings can be repelled from their roosting places with bird glue, but in nesting areas pigeons will frequently make a mat of sticks or straw over the glue and go on nesting as usual

Slide 16.13 – Prepared Bait

- Birds are attracted by bait, sometimes in combination with live decoys. Traps for capturing birds unharmed are available from commercial sources and come in a variety of designs.
- You should use commercial live traps to capture domestic pigeons, starlings, or house sparrows.
- After capturing bird pests, you can either kill them by gassing or transport them for release elsewhere.
- Trapping birds over a large area is not practical but can remove a considerable amount of a bird population.

- Traps should be placed where they will not be disturbed.
 - Bait inside and around the traps with appropriate food and ample water
 - Check all traps daily

Slide 16.14 – Traps

- There are specially prepared compounds approved by the Environmental Protection Agency (EPA) for repelling birds
- These compounds give good results in the management of most pest species and are especially effective against starlings and gulls
- The chemicals are baits, and birds that ingest them become ill almost immediately, emitting distress cries that cause other birds to leave
- Birds ingesting the bait usually die, but only a small percentage of the flock usually eats the bait
- This method is very effective in repelling gulls

Slide 16.15 – Lethal Controls

- Birds removed from traps should be disposed of humanely and out of public view to avoid negative reaction.
- You can use lethal controls against birds that are causing serious problems to buildings or aircraft and cannot be controlled with nonlethal methods
- Never take this type of bird out in the country and release them; they will only return to become a nuisance again. Also, take care to examine trapped pigeons before killing them to be sure no racing or tagged pigeons are killed; these birds will have an identifying leg band.
- For shooting programs, only limited success has been obtained with shooting programs.
- Generally, shooting kills only a small percentage of birds and drives many more away.
- If approved, shooting programs must be carried out continuously for best results.
- The limited residual effect and high cost of this type of management program make it one of doubtful value. Its best use is as a supplement to other more effective techniques.

Slide 16.16 – Poisoning Programs

- Poisoning programs are usually effective against pigeon and sparrow populations, but are of little use against starlings
- Using poisoned bait prevents destruction of non-target animals, including species of birds that do not require control
- If baits are properly placed in or around buildings, there is little probability that birds other than the target species will be poisoned
- Remember to immediately collect bodies of dead birds to eliminate any possibility of secondary poisoning of other animals
- You can purchase poisoned baits commercially or from the US Fish and Wildlife Service in a prepared, ready-to-use form
- Pre-baiting with un-poisoned bait should precede the poisoning program to achieve good bait acceptance

- When indoors, place baits on wide girders or other structural members of airplane hangars, barn lofts, and other spacious enclosed areas to obtain control without resorting to outdoor baiting

Slide 16.17 – Poisoning Programs on Roofs

- On sloping roofs, short, flat boards can be installed, and the bait sprinkled on them
- Keep toxic baits under continuous observation when they are first exposed to make sure non-target birds are not attracted to the area
- Thirty minutes of observation is generally sufficient if pre-baiting was used

Slide 17.1 – Course Completion

Congratulations, you have completed the bird pests, identify, survey & control measures lesson. Please click complete lesson to receive credit.

3E453 – Pest Management Journeyman

Module 3, Lesson 8, Task 1 (11.2) Aircraft Strike Hazard

Slide 1.1 – Introductory Slide

Slide 1.2 – Lesson Title Slide

3E4X3 Career Development Course

11.2 Aircraft Strike Hazard

Slide 1.3 – Instructions

Welcome to the BASH Hazard Identification lesson.

- Upon completion of this lesson, you must be able to successfully identify the relationship of basic facts and state general principles relating to BASH identification with at least 75% accuracy.

Overview

In this section, we will cover the following topics:

- Common Bird Pests
- Common Migratory Bird Pests
- Common Wildlife Pests

Slide 2.1 – Overview Intro

Slide 2.2 – Overview Video

- Video Closed Captions

In and around all runways bird management must be a priority item immediately behind inspector management specialized preventative engineering pest management teams should be involved in planning for if not the actual management of bird problems on military airfields. For specifics on controlling birds on airfields refer to Air Force pamphlet 91-212. Bird Wildlife Aircraft Strike Hazard Management Techniques. The installation management supervisor should request assistance on airfield wildlife problems through the MAJCOM through the BASH team personnel at headquarters Air Force Safety Center Flight Safety Wildlife. The BASH team is a special unit assigned to the Air Force Civil Engineering Support Agency, it specializes in handling bird management problems associated with aircraft operations at Air Force Installations world wide. The team provides special assistance to airbases that have bird problems beyond the local base management capabilities. Request assistance from this highly specialized unit through

normal pest management channels. Proper species identification of birds and other wildlife is an integral part of the BASH program.

Slide 2.3 – Key Takeaways: Overview

- For specifics on controlling birds on airfields refer to Air Force Pamphlet (AFPAM) 91–212, Bird/Wildlife Aircraft Strike Hazard (BASH) Management Techniques
- The installation Pest Management supervisor should request assistance on airfield wildlife control problems, through the Major Command (MAJCOM), from the Bird Aircraft Strike Hazard (BASH) team personnel at Headquarters Air Force Safety Center Flight Safety Wildlife (HQ AFSC/SEFW)
- The BASH team is a special unit assigned to the Air Force Civil Engineer Center (AFCEC/DMP), Tyndall Air Force Base, Florida
- It specializes in handling bird management problems associated with aircraft operations at United States Air Force (USAF) installations worldwide
- The team provides special assistance to air bases that have bird problems beyond the local base management capabilities

Slide 2.4 – Overview Menu

- Common Bird Pest
- Common Migratory Bird Pest
- Common Wildlife Pest
- Note
 - Thorough analyses of wildlife strikes and wildlife surveys/mitigation documentation are required when leadership is recommending management and mitigation efforts.
 - There can be no comprehensive list of every bird and wildlife pest that will be encountered at every base throughout the world, by every airman.
 - The following lists of bird and wildlife pests represent some common pests.
 - Click on each tab to explore the given topic.

Slide 2.5 – Common Bird Pest Menu

- Starlings
- Sparrows
- Seagulls
- Pigeons

Slide 2.6 – Pigeons

- DESCRIPTION
 - 13" long
 - Color varies from snow white to brownish-red, or even multi-colored
 - Most common color is blue or ash gray with a white rump
 - Dark terminal band on tail and two dark crossbars on each wing
 - Usually iridescent (brilliant) green and violet area on neck
- HABITAT
 - Cities

- Towns
- NESTING
 - 1 - 2 eggs per brood
 - Flimsy nest made of sticks and other materials
 - Nests are found in sheltered niches on buildings and cliffs

Slide 2.9 – Sparrows

- DESCRIPTION
 - 5 1/2" - 6 1/2" long
- MALES
 - Brown and black striping on the wings and mantle (back of the neck)
 - Gray crown
 - Chestnut stripe behind a white face
 - Breast is black
- FEMALES
 - Dusky brownish - gray on top
 - Plain gray underside
- HABITAT
 - Cities
 - Towns
 - Ranches
- NESTING
 - White speckled eggs, 5 - 6 pale greenish eggs per brood and 3 - 4 broods per year
 - Builds a nest composed of twigs, grass, paper, and other materials

Slide 2.10 – Seagulls

- DESCRIPTION
 - Sturdy birds with webbed feet, long wings, hooked beak, and possesses exceptional flying ability
 - White with various patterns of gray and black over back, wings, and head
- HABITAT
 - Widespread throughout North America
 - Cause damage to agricultural crops and threaten human safety at airports
- NESTING
 - Nest in colonies and build nests on the ground

Slide 2.11 – Starlings

- DESCRIPTION
 - 7 1/2" - 8 1/2" long
 - Chunky with a short tail
- SUMMER PHASE
 - Black with shimmering greenish-purple gloss
 - Yellow bill (beak)
- WINTER PHASE
 - Dull black, heavily speckled with white spots
 - Dark bill (beak)

- HABITAT
 - Cities
 - Fields
 - Orchards
 - Woodlands
- NESTING
 - Pale blue eggs, 3 – 6
 - Found in tree cavities and on ledges of buildings

Slide 2.8 – Common Migratory Bird Pest Menu

- Canada Goose
- Barn Swallow

Slide 2.9 – Overview

- Canada Goose
 - Canada geese are large birds with a long neck, large body, large webbed feet, and wide, flat bill
 - They have a black head with white cheeks and chinstrap, black neck, tan breast, and brown back
- MIGRATION
 - Fall southern migration period occurs in September and October, and spring northern migration is in March and April
 - Many Canada geese may not migrate at all, due to finding comfortable habitats in refuges and urban/suburban parks
 - Considered one of the most hazardous migratory pests due to population and size of flocks
- HABITAT
 - They are often seen in flight moving in pairs or flocks; flocks often assume a V formation
 - Found near lakes, rivers, ponds, or other small or large bodies of water, and in yards, park lawns, and farm fields
- NESTING
 - Eggs may be white, ivory, or pale tan, with blotches or speckles in either darker or lighter shades than the main color

Slide 2.14 – Barn Swallow

- DESCRIPTION
 - About the same size as a sparrow
 - Appears cone shaped, with a slightly flattened head
 - No visible neck, and broad shoulders that taper to long pointed wings
 - Long outer feathers give the tail a deep fork
 - Steely blue back, wings, and tail, and tawny underparts
 - Blue crown and face with a cinnamon-colored forehead and throat
- MIGRATION
 - Southbound fall migration may begin by late June in Florida or early July in Massachusetts

- They return as early as late January in southern California to mid-May at Alaskan breeding sites
- HABITAT
 - Habitats can include fields, parks, and roadway edges to marshes, meadows, ponds, and coastal waters
 - Mud nests are often easy to spot high under the eaves or inside of sheds, barns, bridges and other structures
- NESTING
 - Eggs are from white to ivory to tan, with heavy reddish-brown speckles/splotches

Slide 2.12 – Common Wildlife Pest Video

- Video Closed Captions

Larger pests may wander into the flightline or runway during takeoffs landings and taxiing requiring the pilot to either hit the animal or engage in evasive maneuvers. This may result in injuries fatalities and damage or destruction of the aircraft. Some common wildlife include deer, coyotes, turkeys, feral dogs, fox's, alligators. moose, bears, and raptors. Japanese beetles are a particular problem in the Azores among other problems where they have been responsible for at least two recently downed aircraft. When they swarm in the flight plan path they damage the turbines inside the engine. Dead animals of any size or type may lure vultures into the airspace. Controlling pests through a thorough integrated pest management program will keep the pests who are most dangerous to aircraft to a minimum.

Slide 2.13 – Key Takeaways: Common Wildlife Pest

- Common wildlife pests include:
 - Deer
 - Coyotes
 - Turkeys
 - Feral dogs
 - Foxes
 - Alligators (in Florida/some Gulf Coast or other tropical areas)
 - Moose (in Alaska and northernmost states)
 - Bears (in Alaska and northernmost states)
- Japanese beetles are a particular problem in the Azores, amongst other places, where they have been responsible for at least two recently downed aircraft

Slide 3.1 – Course Completion

Congratulations, you have completed the BASH identification lesson. Please click complete lesson to receive credit.

3E453 – Pest Management Journeyman

Module 3, Lesson 8, Task 2 (11.1) Survey Methods, Bird Aircraft Strike Hazard (BASH)

Slide 1.1 – Introductory Slide

Slide 1.2 – Lesson Title Slide

3E4X3 Career Development Course

11.1 Survey Methods, Bird Aircraft Strike Hazard (BASH)

Slide 1.3 – Instructions

Welcome to Survey Methods for the Bird/Wildlife Aircraft Strike Hazard (BASH) lesson.

- Upon completion of this lesson, you must be able to successfully identify the relationship of basic facts and state general principles relating to survey methods to support BASH efforts with at least 75% accuracy.

Overview

In this section, we will cover the following topics:

- Overview
- Bird Aircraft Strike Hazard
 - Formal Survey
 - Habitat

Slide 2.1 – Overview Intro

Slide 2.2 – Overview

- The BASH team is a special unit assigned to the Air Force Civil Engineer Center, Tyndall Air Force Base, Florida.
- The installation Pest Management Supervisor requests assistance on airfield wildlife control problems, through the Major Command (MAJCOM).
- As Pest Management, you may be required to assist the BASH team depending on the installation.

Slide 3.1 – Bird Aircraft Strike Hazard (BASH) Intro

Slide 3.2 – Bird Aircraft Strike Hazard (BASH)

- Formal Survey
 - BASH personnel will conduct formal daily and nightly wildlife surveys throughout the year and forward the data to the BASH Program Manager.

- Local conditions that enhance the potential for wildlife/aircraft strikes vary at each installation.
- Tasks may involve photographing and summarizing all wildlife hazards on the installation
- Document the relative size and abundance of insect and weed species present, since both contribute to the presence of wildlife on the airfield
- Small, unmanned aircraft or radio control vehicles with cameras have the potential to provide valuable wildlife diversity, abundance, habitat, behavior, and location information without dispersing or flushing the wildlife into the exclusion zone.
- Air Force Pamphlet (AFPAM) 91-212 provides guidance on controlling birds in or around an airfield in support of the BASH program.
- Habitat
 - FOOD
 - Birds require relatively large amounts of food
 - Airfields can support an abundance and variety of foods such as seeds, berries, grass, insects, grubs, earthworms, small birds, and small mammals
 - WATER
 - Fresh water is one of the most important airfield wildlife attractants, especially in arid regions and near the seacoast
 - Standing water (from rain, drainage, or cleaning operations) creates a source of drinking water and a breeding place for insects, amphibians, and other food
 - COVER/HANGARS
 - Grass exceeding 14 inches (36 cm) will attract some bird species and rodents, which, in turn, attracts raptors
 - Grass that is too short (less than 7", 17.75 cm), however, makes the terrain more attractive for birds digging for grubs
 - Provide a safe environment for birds to nest and roost
 - Easily accessible to birds since the doors are usually left open for long periods
 - LANDFILLS
 - Provide food sources and loafing areas that attract and support thousands of seagulls, starlings, pigeons, and other species
 - A major attraction for seagulls, a bird very commonly involved in bird strikes

Slide 4.1 – Course Completion

Congratulations, you have completed the Survey Methods, Bird Aircraft Strike Hazard (BASH) lesson. Please click complete lesson to receive credit.

3E453 – Pest Management Journeyman

Module 3, Lesson 8, Task 3 (11.3) Mitigation Practices, BASH

Slide 1.1 – Introductory Slide

Slide 1.2 – Lesson Title Slide

3E4X3 Career Development Course

11.3 Mitigation Practices, BASH

Slide 1.3 – Instructions

Welcome the Mitigation Practices, BASH lesson

- Upon completion of this lesson, you must be able to successfully identify relationship of basic facts and state general principles relating to mitigation practices to support BASH efforts with at least 75% accuracy.

Overview

In this section, we will cover the following topics:

- Overview
- Control Methods
- Passive Control Methods
- Cultural Controls
- Ineffective Methods of Control

Slide 2.1 – Mitigation Practices Overview Intro

Slide 2.2 – Mitigation Practices Overview Video

- Video Closed Captions

Aircraft collisions with wildlife cause millions of dollars in damage annually resulting in the loss of combat capability, aircrews, and aircraft. Damage to airfield infrastructure by burrowing animals degrades airfield surfaces presenting additional hazards. Wildlife strike hazards to aircrew and aircraft (as well as operations and maintenance expenditures) may be significantly reduced by utilizing an integrated pest management approach, resulting in substantial savings of United States Air Force resources. In 2019, bird strikes in the US affected more than 17,000 commercial, government/military, and private aircrafts. In 2020, the number dropped by more than 6,000 bird strikes, due to the COVID-19-driven decrease in flights. Guidance for controlling flight line pests can be found in AFPAM 91-212. Active and passive techniques can successfully reduce threats from hazardous wildlife populations. Techniques vary in cost and effectiveness depending on the situation. Even when dispersed to a "safe" portion of the airfield, birds can

move and create an immediate hazard. Birds may also act as decoys that attracts raptors
Integrated pest management (IPM) provides the best line of defense for immediate hazards.

Slide 2.3 – Key Takeaways: Mitigation Practices Overview

- Aircraft collisions with wildlife cause millions of dollars in damage annually, resulting in the loss of combat capability, aircrews, and aircraft.
- Guidance for controlling flight line pests can be found in Air Force Pamphlet (AFPAM) 91-212.
- Active and passive techniques can successfully reduce threats from hazardous wildlife populations.
- Even when dispersed to a "safe" portion of the airfield, birds can move and create an immediate hazard.
- Integrated Pest Management (IPM) provides the best line of defense for immediate hazards.

Slide 3.1 – Control Methods Intro

Slide 3.2 – Control Methods Menu

- Pyrotechnics
- Bioacoustics
- Depredation
- Propane Gas Cannon
- Falconry
- Dogs
- Physical Removal

Slide 3.3 – Pyrotechnics

- Noise-producing devices are effective in bird dispersal
- Can be used to flush and direct flocks of birds in a desired direction
- Coordinate with the control tower so birds are not directed into the path of arriving or departing aircraft

Slide 3.4 – Bioacoustics

- Uses broadcasts of recorded bird distress calls
- Sound source must be properly placed so the birds fly away from the runway
- Do not allow the distress calls to play indefinitely because birds can become accustomed to them
- Effectiveness is dramatically increased when combined with other frightening techniques, especially pyrotechnics

Slide 3.5 – Depredation Video

- Video Closed Captions

Lethal removal of birds may be necessary. This can be done by attaining a migratory bird permit from the U.S. Fish and Wildlife Service. Often employed for species like Canada Geese which occur in huge numbers and are hard to remove. Birds may only be killed in conjunction with a continuing non-lethal control program. Carcasses, nests, and eggs shall be completely destroyed or incinerated. No federally listed threatened, or endangered species, or bald, or golden eagles or their nests and or eggs are authorized.

Slide 3.6 – Key Takeaways: Depredation

- Lethal removal of birds may be necessary and can be done by obtaining a migratory bird permit from the United States (US) Fish & Wildlife Service.
- Birds may only be killed in conjunction with a continuing non-lethal control program.
- Carcasses, nests, and eggs shall be completely destroyed or incinerated.
- No federally listed threatened or endangered species, bald or golden eagles, or their nests and/or eggs are authorized.

Slide 3.7 – Dogs

- Use of border collies or other herding dogs to disperse geese and other pests has been effective under some circumstances
- Have a herding instinct they use to move birds from one area to another

Slide 3.8 – Physical Removal

- In some cases, physical bird removal is the best option
- When birds are nesting in the vicinity of an airfield
- With eagles, many airports work with the U.S. Fish & Wildlife Service to obtain a migratory bird permit to re-locate nests that pose a potential risk

Slide 3.9 – Falconry

- Falcons trained for airfield bird dispersal may be effective when used in combination with other frightening techniques
- Usually disperses birds immediately from the airfield
- Birds are likely to remain away from the airfield for longer periods

Slide 3.10 – Propane Gas Cannon

- Produce a loud boom sound that scares birds away from the airfield
- Should be operated at dawn and dusk, as birds come in to feed or roost
- Must be relocated frequently to avoid habituation problems

Slide 4.1 – Passive Control Methods Intro

Slide 4.2 – Passive Control Methods

- GRASS MANAGEMENT/LANDSCAPING
 - Grass should be mowed to a height of 7-14 inches.
 - Faster growing weeds should be cut before they go to seed to discourage seed-eating birds from using the airfield.
 - There should be no ornamental plants, trees, or shrubs on the infield areas.
 - Trees near the airfield should be properly pruned to mitigate bird populations
- HERBICIDES
 - Keep broad-leafed weeds to a minimum on the airfield.
 - Apply herbicides as practical to control weeds.
- FENCING
 - Can reduce airfield incursions by wildlife other than birds.
 - 8-foot chain-link fence topped with outward-facing outriggers and 3 strands of barbed wire should be used to exclude deer, coyotes, and other wildlife.
 - Bottom of the fence must be properly secured at or underneath the ground to prevent animals from digging or pushing under the fence.

- **NETTING**
 - Excellent long-term defense against birds returning to hangars.
 - Prevents birds from roosting inside the hangar while allowing the doors to be open during hangar operations.

Slide 5.1 – Cultural Controls Intro

Slide 5.2 – Cultural Controls

- **Modification of Flight Schedules**
 - Excellent long-term defense against birds returning to hangars.
 - Prevents birds from roosting inside the hangar while allowing the doors to be open during hangar operations.
- **Radar and Risk Prevention Tools**
 - Can help pilots spot and avoid potential bird hazards.
 - For instance, Doppler weather radar is used to spot bird activity along flight routes.
 - Radar has been used as a secondary layer of information, along with bird survey data, to implement the Avian Hazard Advisory System (AHAS).
 - Pilots use it to evaluate potential flight collision risk in an area.

Slide 6.1 – Ineffective Methods of Control Intro

Slide 6.2 – Ineffective Methods of Control

- **Stuffed Owl and Rubber Snake**
 - Have been advertised to rid hangars and buildings of birds
 - They are usually a waste of money and effort
- **Rotating Lights**
 - Generally considered ineffective
 - Birds quickly habituate to these devices
- **Ultrasonic Device**
 - Proven unsuccessful in deterring wildlife from colliding with aircraft
 - Very few bird species can hear ultrasonic sound

Slide 7.1 – Course Completion

Congratulations, you have completed the Mitigation Practices, BASH lesson. Please click complete lesson to receive credit.