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Techniques and Approaches for the Removal of Feral Pigs from Island and Mainland Ecosystems

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ABSTRACT: Feral pigs cause considerable damage to island and mainland ecosystems around the world. Eradication efforts can be extremely challenging and may require many years. Some techniques used in removal programs include: trapping, hunting with dogs, ground hunting, aerial shooting, and fencing. Trapping can be very successful when pig densities are high and natural forage is at a minimum. Dogs can be used at any time, but are best used when pig densities are moderate to low, and during the cool wet months of the year. Ground hunting techniques are valuable throughout an entire eradication process because they can be used opportunistically with other techniques and often remove pigs less susceptible to other methods. Aerial shooting can be very effective in certain situations where the terrain permits easy location of animals from the air. Fencing, while expensive, can prove indispensable for pig eradication projects and can be used to contain a population, divide a population, or exclude animals from sensitive areas. The difficulty of performing a pig eradication project can be compounded by logistically challenging aspects of working on an island. However, islands have the distinct advantage of not requiring a perimeter fence, and upon completion, the island will remain pig-free unless pigs are intentionally reintroduced. Mainland pig eradication projects depend entirely on the integrity of a perimeter fence. Therefore, there is a constant threat of pigs becoming reestablished if the fence integrity is compromised. Thus, a perimeter fence must be vigilantly monitored during eradication and indefinitely afterward. A flexible plan with solid financial backing is necessary for any eradication project to be successful. Finally, safety is the number one concern when working in remote field locations and handling firearms.

KEY WORDS: eradication, fencing, feral animals, hunting, islands, pigs, *Sus scrofa*, trapping

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INTRODUCTION

Eradicating feral pigs (*Sus scrofa*) from any ecosystem is a daunting task. They are a highly adaptable species with impressive reproductive capabilities that prosper in a variety of habitats throughout the world.

While there are key differences between eradicating feral pigs from island and mainland ecosystems, a variety of removal techniques can be effectively applied to feral pig populations in both situations. The techniques we will discuss include trapping, hunting with dogs, ground hunting, and aerial hunting with helicopters. In addition, fencing for containment, exclusion or subdivision of a pig population can be an important tool. Over the past 14 years, we have used these techniques to remove over 12,000 pigs from various island and mainland based project sites.

Trapping

Trapping is most effective at the beginning of a project, when pigs are numerous and naïve. This technique is more effective when natural forage is limited or of poor quality, such as during the dryer months of the year. Traps should be placed in areas that pigs frequent, such as water sources or in regular foraging areas, and located along lanes of travel to increase encounter rates. Trapping can also be very effective in closed habitats where other methods are more difficult to employ.

Because traps often can be left open for 24 hours a day they are less dependent on the time of day that pig activities occur, however, as stationary devices they are a passive form of removal and will not effectively target all pigs in a population.

Some traps are designed in a "corral" configuration, whereby stakes are set in the ground and fencing or paneling is traditionally used to construct the sides around a doorframe. These traps are usually large (>4 m²) and capable of capturing multiple pigs each time they are set. At the opposite end of the spectrum are "box" traps, which can be made in a variety of sizes but are normally built small enough (e.g., <1.3 × 1.3 × 2 m) to be easily moved in the field by hand and typically have a guillotine-style door. Generally, only a single animal is caught, but several smaller-sized animals can be captured simultaneously in these designs.

Another effective configuration is a "panelized corral trap" design that borrows the best qualities of both the corral trap and the box trap. Our design utilizes a 2.4 × 2.4-m or 2.4 × 3-m rectangular configuration and consists of 4 tubular frame panels covered with chain link (3 side panels and one door panel), which are wired or shackled together at the corners. This design is large enough to capture multiple pigs like a corral trap, but can be broken down into smaller units to be carried by hand in the field like a box trap. The traps can also be bundled and flown

into remote locations by helicopter. Additionally, if desired a number of panels can be wired together to make a corral style trap of a larger size. In sandy soil or uneven terrain, we will often install a bottom to the trap by attaching a heavy-gauge, welded wire panel to the frame and then covering the wire with dirt. The door is a swinging design that is held up by a trigger stick or lever arm, which is tripped by a length of cord running from the trigger, through a bait bucket and then tied to the back of the trap. When pigs knock the bucket over, the trigger is tripped and the door falls and locks into place, preventing pigs from escaping.

A variety of baits may be used to lure pigs to traps. These include whole kernel and cracked corn, fermented corn, commercial pig feed, vegetables, fruits, meats and a number of natural forage items, such as acorns or other mast crops, which can be collected in the field. However, we have found that corn or a granular corn-based commercial pig feed works well in most environments and is typically the most practical choice due to its commercial availability, convenient storage and transport, and ease of use in the field. An additional advantage of the pelletized feed is that it is colored similar to soil and thus less obvious than other baits to non-target species such as crows and ravens that will consume pig bait in the field. However, whole-kernel or cracked corn may be a better choice for areas that receive considerable precipitation, as granular pig feed will dissolve in water.

Scent attractants, such as urine from a sow in estrous, may also be used to lure pigs to trap sites. They are probably more effective when pig densities are low or during certain times of the year (e.g., when sows are receptive to breeding), but are most practical when used in conjunction with a proven food bait.

Prebaiting of traps is highly recommended. Baiting approximately 2 weeks prior to setting helps ensure that pigs in the area find and begin frequenting trap sites. Typically, we lock trap doors in the open position to allow pigs to become comfortable with entering the traps. In this way, it is possible to capture large numbers of pigs in the first few nights of trapping.

If a large trap line is to be operated by a small group of employees, radio transmitters can be affixed to remote traps with a segment of fishing line tied to the door at one end and the transmitter magnet at the other end, such that when the door falls the magnet is pulled off of the transmitter and the signal transmission begins. In this way, employees can check traps from remote locations without disturbing the trap site, and can focus their time on other removal efforts. Automatic feeders can be used in conjunction with transmitters so that employees only check traps when the door is down (and a telemetry signal is present), or once a week to refill feeder buckets, thus freeing up a great deal of time for other removal activities. Additionally, 55-gallon drums with sealable lids are useful for storing bait in remote locations. They will protect the bait from all wildlife and can be flown in by helicopter when the traps are positioned.

Hunting with Dogs

A variety of dog breeds can be used for pig hunting. Examples include Catahoula, Plott, Mountain Kerr,

Redbone, Walker, Blue Tick, Black and Tan, Pit Bull Terrier, and Bulldog breeds, and any number of other breeds including mixes of the above listed. Catahoula, Plott, and Mountain Kerr breeds tend to be good all-around dogs for pig hunting because they will track fresh scent and are capable of baying or catching pigs. Redbone, Walker, Black and Tan, and other hounds are suitable for following older scent and will typically hold pigs at bay. Finally, Pit Bull, Bulldog, and other sturdy breeds are best used to catch pigs after other dogs have bayed them.

The breed of dog necessary will vary depending on the circumstances of specific eradication projects such as topography, climate, and the size of the pigs. The all-around breeds, such as Catahoulas and Plotts, are practical and effective in most cases. However, as pig numbers dwindle, hounds may be able to detect and track more faint scent trails that other breeds cannot detect. If thick vegetation prevents hunters from quickly arriving on scene when a pig is bayed, then catch dogs may be necessary to quickly grab the pig and prevent it from escaping or injuring the bay dogs.

Hunting with dogs is unique in that it does not depend on pig behavior, thus pigs that are less susceptible to other techniques, and the last remaining few in a removal area, are prime targets for removal with the use of dogs. We typically hunt with dogs after other techniques have significantly reduced the pig population on an eradication site. While dogs could be used at the onset of eradication activities, and they certainly would catch pigs when densities are high, other techniques such as trapping can prove more efficient at removing large numbers of pigs in many parts of the world. Dogs are most effective during cool, wet months because they can more easily track scent and are less likely to overheat.

Dogs are often underutilized because of concerns about disturbance of non-target wildlife species, visitor disturbance, and humane treatment issues for both dogs and pigs, but they can be very effective if properly trained and used correctly. Protective collars and vests can be used to protect the dogs from injury caused by the pigs. Shock collars can be used to break dogs of chasing non-target species, which is an important consideration in most locations. Dogs should be equipped with telemetry collars, as they may bay up pigs outside of earshot. Telemetry can reduce the amount of time necessary for field staff to locate the dogs and thereby reduce risk of injury to dogs from pigs.

Ground Hunting

Our definition of ground hunting includes the following subcategories: stalking, stand hunting, trail and road hunting at night, bait-site hunting, and opportunistic shooting. A variety of firearms, sights, and illumination devices can be used in ground hunting situations depending on the terrain, time of day and weather. Typically, high-power, centerfire calibers such as .270 Winchester are used in spot-and-stalk, stand hunting, bait site hunting, and spotlighting or whenever long-range shots are necessary. Rifles chambered in a lower velocity centerfire cartridge, such as .44 Remington Magnum, and shotguns are a good choice for hunting in thick vegetation

or on foot at night where shots will likely be less than 100 meters. Night vision riflescopes, goggles, or handheld scopes can be helpful for nighttime operations, but they have limitations with regard to weather, ambient light, and vegetation. A less expensive alternative is firearm-mounted tactical lights, which have proven effective for ground hunting after dark.

The application of these ground hunting techniques over the entire removal process often facilitates collection of animals that are less susceptible to other techniques (e.g., will not enter traps). Furthermore, pigs can be taken opportunistically through ground hunting techniques while employees engage in other removal activities (e.g., trapping).

Use of Helicopters

Helicopters are valuable for transporting traps, equipment, and personnel to remote locations and can be used for aerial hunting or for surveying purposes. They are most effective in open areas where animals can easily be located and cannot readily escape into cover. Large numbers of pigs can be removed by aerial hunting techniques in a short period of time relative to other techniques, if the terrain permits. However, because of the cost of operating a helicopter, aerial hunting should only be used when it is more efficient than other methods or perhaps when the timeline calls for quick removal of animals.

The chief limitation of the aerial shooting technique is the ability of the shooter and pilot to locate and approach animals in the landscape. At the beginning of an aerial hunting campaign, pigs will be naïve and far easier to locate. Over time, surviving animals will habituate to the sound of the helicopter and seek cover long before the helicopter arrives. As pig density declines, the use of this technique will result in diminishing returns as "seek" time increases.

Variations on the use of helicopters include incorporating forward-looking infrared (FLIR) devices mounted on the helicopter that allow pigs to be detected by sensing their heat signature. While FLIR will not detect animals through vegetation, it increases the probability that semi-cryptic species will be detected at a higher rate than with unaided vision. Because FLIR works by displaying heat emitted in the infrared, it best used in the early morning or late evening hours (or during the winter) when heat radiated from the pigs is significantly greater than the surrounding environment.

Fencing

Fencing, while expensive, can prove indispensable for pig eradication projects. Depending on the size, location, and management goals of the land to be cleared of pigs, fencing can be used to contain a population, divide a population, exclude pigs from sensitive areas, or deny them access to water. Most pig fencing incorporates a woven wire-type fence material from the ground up to about 75 cm high, and then 2 - 3 strands of barbed wire above, resulting in a fence 100 - 110 cm tall. The fence is typically anchored into the ground along its length to prevent pigs from digging under. If a large area is to be cleared of pigs, fencing can be used to divide the area into

manageable subunits for systematic eradication. An important advantage of sectional fencing is that if the project is delayed due to funding or legal actions, the units that have been cleared of pigs will have a greater probability of remaining pig-free until the project is resumed. In non-island situations, containment and isolation of a pig population is paramount for eradication to be successful. The fence must be checked regularly and maintained indefinitely, which will be a considerable cost to the managing agency responsible for the land. Depending on the size of the fenced area, the entire fence line should be walked at least quarterly and after any significant storm events. Any indications that pigs have breached the fence would require that those animals be found and dispatched.

Additionally, before a fence is constructed its affect on the native wildlife should be considered. Is it going to hinder the movement of native species, such as large ungulates or predators? Visitor use and aesthetic impacts should also be considered.

A COMPARISON OF ISLAND AND MAINLAND ERADICATION PROJECTS

In the following sections, we provide a comparison of a mainland and an island ecosystem eradication effort and the specific considerations that were necessary to conduct these programs.

Santa Catalina Island

Santa Catalina Island is administered by the Catalina Island Conservancy and is located 40 km off the coast from Long Beach, California. It is approximately 19,400 ha of topographically and vegetatively diverse habitat. In 1997, the island was fenced into 4 zones varying in size from 3,600 - 6,500 ha, using 3 fencelines that transected the island. Weather varies from warm, dry summers to cool, moist winters. This eradication effort is described in detail in Garcelon et al. (2003).

Island Considerations

The difficulty of performing a pig eradication project can be compounded by logistically challenging aspects of working on an island. Obtaining the necessary equipment for the job in a timely fashion is often difficult on islands because it has to be shipped by barge. Maintenance resources and facilities are often in short supply, causing repairs to roads, equipment and vehicles to take longer compared to the mainland. It can also be difficult to keep employee morale high in an isolated island situation, as amenities found on the mainland may be in short supply on islands. These factors can result in high turnover rates in staff, the outcome of which means more time spent hiring and training new employees and less time spent eradicating pigs.

Islands have the distinct advantage of not requiring a perimeter fence. Once the eradication is completed, the island will remain pig-free unless pigs are intentionally reintroduced. This results in a lower initial cost of eradication (less fence line per area) compared to a site on the mainland and much reduced long-term maintenance costs. Depending on the size of the island, a series of fences can be constructed to divide it into manageable

subunits. In this situation, a major concern is between-zone fence integrity. Once a zone is cleared, it must be maintained pig-free for a systematic approach to be feasible. Otherwise, removal activities will be diverted from actively hunted zones and used to repeatedly clean up zones that were previously "pig-free". This will detract from the overall success and timely completion of the eradication project.

Pinnacles National Monument

Pinnacles National Monument (PNM) is administered by the National Park Service and is located approximately 130 km south of San Jose, California. The Monument is approximately 9,700 ha, 5,700 of which are enclosed by a pig-proof fence. The terrain at PNM is steep and thickly vegetated. The primary woody vegetation located on mountain tops and canyon sides consists of chamise (*Adenostoma fasciculatum*) and mixed chaparral species. Slopes and canyon bottoms are dominated by mixed riparian woodland species such as oak and pine. The climate is very hot and dry from May to November with a cool, wet season from December to April.

Mainland Considerations

Mainland pig eradication projects offer challenges above those on islands, as they depend entirely on the integrity of the perimeter fence. Typically, pigs will exist at a similar density outside of the fence as they do inside the fence at the beginning of a project. When they encounter the fence, they will walk along its length and establish trails. Therefore, there is a constant threat of their becoming reestablished if the fence integrity is compromised. Even a small opening in the fence may allow considerable numbers of pigs into the enclosure, as they are effectively led to the openings by the fence itself. Thus, a perimeter fence must be vigilantly monitored. If possible, control efforts should be employed in the area outside the fence to keep pig density low and prevent a large number of pigs from entering if a breach in the fence does occur.

Because of the danger of fence failure on the mainland, a parallel, double fence spaced 100 m apart encompassing the entire eradication site would greatly reduce the probability of a catastrophic breach (Figure 1). Transverse cross sections established every kilometer between the double perimeter fences would contain the pigs to a relatively small area should an outer fence breach occur, and the probability of an inner and outer fence breach in the same 1 kilometer section should be rare. While such a fence would be more than twice as expensive as a conventional fence in initial cost, it might prove more cost effective in the long run if it prevents pigs from reentering the enclosure and requiring additional removal efforts after the initial eradication has been completed. As mentioned above, a maintenance level hunting and trapping program could be established around the perimeter of the fence to create a buffer zone that would keep pressure off of the fence. The combination of regular fence maintenance, a double fence and buffer zone pig control could provide a comfortable level of protection to a pig-free enclosure.

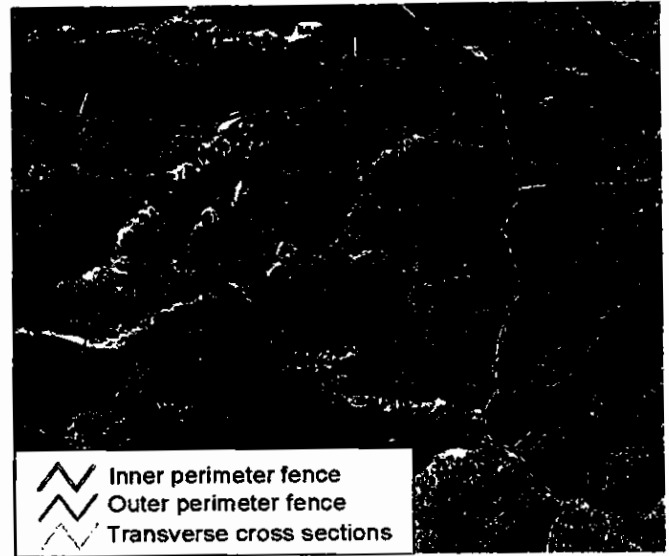


Figure 1. Double perimeter fence with transverse cross sections.

Considerations for both Island and Mainland Situations

Safety is the number one concern for any eradication project. Employees must be able to conduct themselves safely in the field, especially when carrying and discharging firearms on public lands. Firearms safety, defensive driving, ATV operation, first aid training, and other related courses should be completed by project staff, if deemed necessary. Good communication among field staff is also of primary concern, as it will not only improve coordination in hunting efforts but will increase safety in case of injury or accidents.

Private landowner cooperation is valuable for both island and mainland situations. A good relationship with local landowners can afford access to landlocked areas and provide regular information on the local political and social environment. Public perception is important, and a level of professionalism should be maintained at all times. Employees should be well versed in the responsibilities of their appointment and be able to communicate about the project's justification and goals with people they encounter. There will always be some opposition to eradication projects, sometimes strong enough that it leads to sabotage attempts. Vandalism of pig fence and even traps and vehicles can slow a project or cause serious setbacks.

In any eradication project, an effective monitoring system must be established to track the pig population as it declines. A series of transects using topographic features, trails, and roads where available can be established and walked on a scheduled basis in search of pig tracks, scat, or other sign to provide consistent data on the pig population. Bait sites can also be established and checked on a daily or weekly basis, and trail cameras can be positioned to record any activity.

Solid financial backing is a must for a pig eradication project to be successful. Dependable funding allows for an aggressive program without delays that can effectively keep pressure on a pig population. As eradication

programs often involve several years of intense effort, delays caused by lack of funding can lead to the loss of experienced field personnel and possibly lead to pigs becoming reestablished in areas previously made pig-free. Finally, flexibility in the removal plan and its implementation is necessary to allow latitude for dealing with the problems that will inevitably arise over the course of an eradication project.

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