Management of non-native Argentine Ants; Santa Cruz Island

Channel Islands National Park, California

January 15, 2015

Abstract

The purpose of this project is to further the protection and restoration of the naturally functioning ecosystem of Santa Cruz Island through the containment, control, or elimination of non-native Argentine ants (*Linepithema humile)*. Santa Cruz Island is one of five islands within Channel Islands National Park (CINP). The National Park Service owns the eastern 24% of the island and The Nature Conservancy (TNC) owns the western 76%. Argentine ants have spread significantly since their accidental introduction to Santa Cruz Island, thought to have occurred in the 1960s. Since their initial discovery in two locations in 1996, the ants have established in two additional locations and increased the size of each colony. CINP and TNC have implemented measures to limit the unintentional transport of Argentine ants to and within Santa Cruz Island. Nonetheless, the evidence suggests that Argentine ants will continue to spread unless there is management action to control or eliminate the infestations. Laboratory and field trials were conducted beginning in 2011. After extensive research and consultations with experts, several promising commercial baits and distribution methods were selected for their potential to control or eliminate Argentine ants. NPS and TNC propose to use a low concentration pesticide, sucrose, and hygroscopic polyacrylamide beads to eliminate Argentine ants. This bait is distributed via helicopter or by hand in sensitive areas. For up to 10 years after the intensive treatments NPS and TNC would monitor the infestation areas for remnant ant nests, and spot-treat any detected Argentine ants.

Contents

Section 1. Purpose and Need

The purpose of this project is to further the protection and restoration of the naturally functioning ecosystem of Santa Cruz Island through the containment, control, or elimination of non-native Argentine ants (*Linepithema humile)*. Santa Cruz Island is one of five islands within Channel Islands National Park (Figure 1). The National Park Service (NPS) owns the eastern 24% of the island and TNC owns the western 76% (Figure 2).

Figure 1. California Channel Islands

The mission of the National Park Service is to preserve unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The enabling legislation for Channel Islands National Park recognizes the value and appropriateness of achieving goals through projects anywhere on Santa Cruz Island and authorizes the

use of federal funds on privately-held portions of the Park in order to protect and restore resources. The 1985 General Management Plan/EA, 2002 Santa Cruz Island Primary Restoration Plan/EIS, and the 2013 Draft General Management Plan/EIS established goals of managing or removing non-native plants and animals as feasible and where important to protect naturally functioning ecosystems and biological diversity.

The mission of The Nature Conservancy (TNC), a private non-profit conservation organization, is to preserve plants, animals, and natural communities and the biological diversity they represent by protecting the lands and waters they need to survive.

Figure 2. Santa Cruz Island, California

Action is needed because the Argentine ants have spread significantly since their accidental introduction to Santa Cruz Island, thought to have occurred in the 1960s. Since their initial discovery in two locations in 1996 (Calderwood et al. 1999), the ants have established in two additional locations and increased the size of each colony (Coastal Restoration Consultants 2009, FBA Consulting 2010, Hanna and Boser 2013). Therefore, NPS and TNC expect that Argentine ants will continue to spread unless there is management action to control or eliminate the infestations. Argentine ants are known to infest approximately 1180

acres in four areas of Santa Cruz Island: the University of California (UC) Reserve Field Station, the Navy Blue Site, Cañada del Puerto and Valley Anchorage (Figure 3).

Biology and ecology of Argentine ants

Argentine ants are native to South America. They are easily spread by humans, termed "jump-dispersal" (Suarez et al. 2001) and currently occur on every continent except Antarctica. Colonies can slowly spread overland as they grow in size or move overland to more suitable habitats. In California, the Argentine ant is the most common ant found in urban areas (Powell and Hogue 1979).

Argentine ants form extensive and dense colonies with multiple queens. The widespread distribution reduces the likelihood of successful eradication of Argentine ants in most mainland locations.

Argentine ant queens do not fly or undergo mating flights and new colonies disperse and move to new territories only through budding. This type of "on-foot" dispersal limits the rate of spread to about 100 m/year (Suarez et al. 2001). These limitations permit unambiguous delineation of invaded areas and greatly facilitate control. For instance, the lack of flight virtually eliminates the chances of new infestations occurring at distant sites except with the exception of colonies carried to new sites by human activities or by flood waters.

Ecological impacts of Argentine ants and potential for control

Argentine ants can have significant impacts on the functioning of an ecosystem because of their strong competitive ability and broad diet (Holway 1998, Holway et al. 2002). Resources potentially at risk on Santa Cruz Island include a number of endemic insect species (Wetterer et al. 2000, Powell 1994) and 70 species of nesting landbirds, 10 of which are endemic to the island or to the Channel Islands. Santa Cruz Island is the entire range of the Island Scrub-Jay, the only insular endemic species of bird in the contiguous 49 states. Argentine ants affect the native invertebrate community through direct predation, competition, interference, and egg predation (Ward 1987, Human and Gordon 1997, Cole et al. 1992, Krushelnycky and Gillespie 2008, Lach 2008). Native ants are particularly vulnerable and are largely eliminated in the presence of Argentine ants. This impact has been observed on Santa Cruz Island (Hanna et al. *in press*). Argentine ants also kill young birds in nests by swarming over them in large numbers (Banko et al. 2002). While Argentine ants currently do not inhabit nesting locations of sensitive seabird species, such as the ashy storm petrel and Scripp's murrlet, if left uncontrolled, the Argentine ants would spread to those locations and could impact the reproductive success of those species.

Recent technological and methodological advances have increased the feasibility of invasive ant eradication (Hoffmann et al. 2010). Insecticidal baits currently offer the most effective strategy for eradicating invasive ant populations, while minimizing non-target effects. Insecticidal baits take advantage of trophallaxis (i.e. food exchange) within an ant colony; foraging workers feed on the bait in the field, return to the nest, and then transfer the bait to queens and other workers, which continue to share the bait with other nest mates.

Argentine Ants on Santa Cruz Island

The cool maritime climate of the Channel Islands appears highly conducive to the Argentine ant as evidenced by actively advancing fronts of *L. humile* on SCI (Boser 2011). All of the observations and data

gathered to date indicate that Argentine ants will continue to spread in the absence of control efforts, however, inherent limitations in the dispersal rates of *L. humile* greatly enhance the feasibility of their control and eradication on SCI.

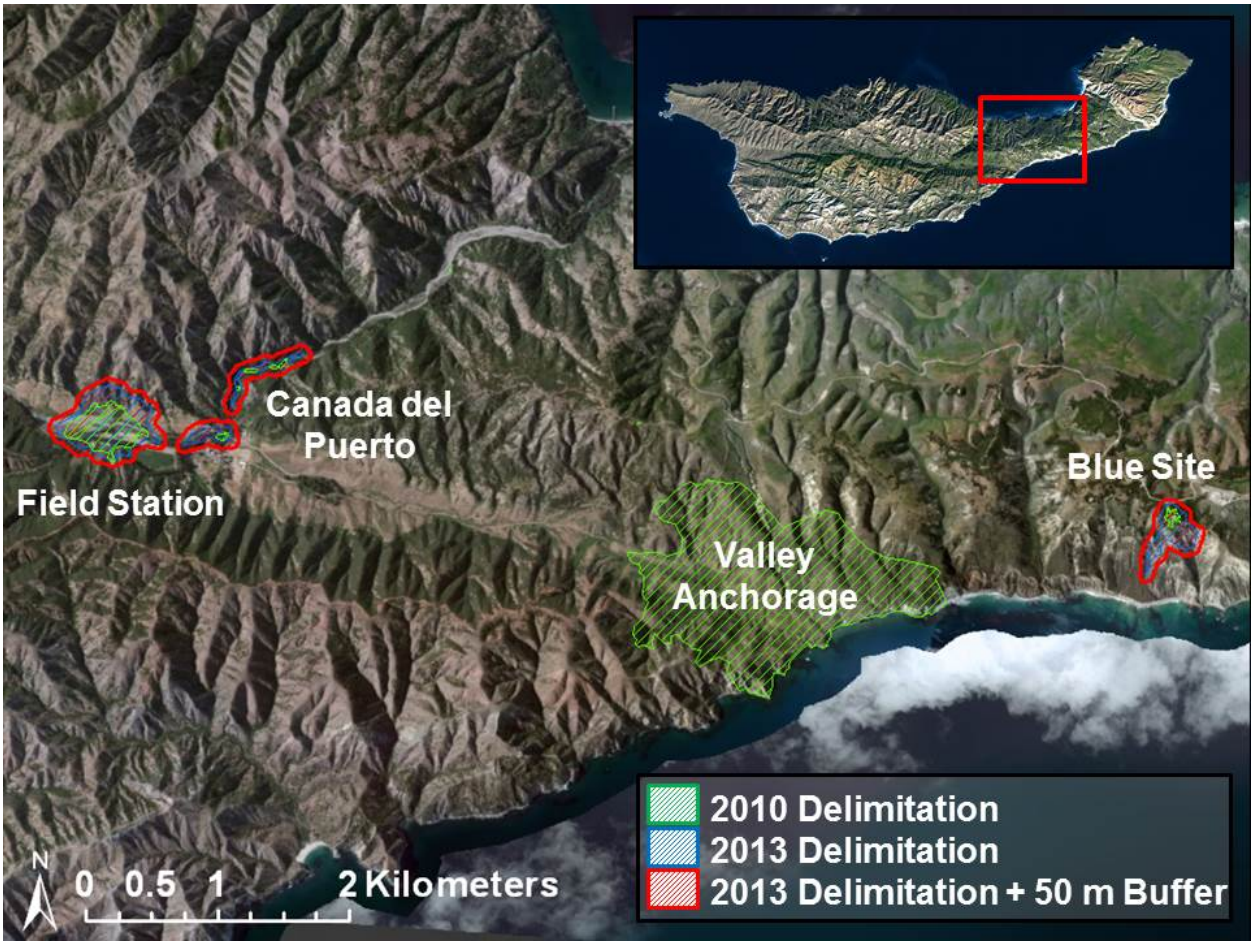

Figure 3. Map of Argentine ant infestations based on ground surveys on Santa Cruz Island, CA in 2010 (green), 2013 (blue). Areas treated as a field trial in 2013 (red) include an additional 50 meter buffer (red).

Extent of infestation

The presence of Argentine ant colonies near the Cañada del Medio and Cañada del Puerto drainages increases the likelihood that colonies will be swept downstream during periods of high water flow and would eventually colonize the lower portions of the drainage, including the Prisoner's Harbor area. Colonization of the Prisoner's Harbor area would greatly increase the potential for accidental spread by humans to Argentine ants to new locations on the island. Additionally, the presence of Argentine ant colonies at the airstrip and some developed areas in the Central Valley greatly increases the potential for spread by human activities (Table 1).

Table 1. Characteristics of Argentine ant infested sites, likelihood of spread and treatment accessibility.

	Acreage (with 50 meter buffer)	Likelihood of amoebic, overland spread	Likelihood of human-assisted dispersal
U.C. Reserve	94	Very high	Very high
Valley	1600	Very high	High
Blue Site	40	Very high	Low
Cañada del Medio	21	Very high	Low
Cañada del Puerto	28	Very high	Low

Research and field trials on Santa Cruz Island to date

Due to the documented environmental impacts of the invasive Argentine ant (Hanna et al. *in press*, Holway 2002), the Argentine ant working group recommended that control or eradication efforts be conducted on Santa Cruz Island (Randall et al. 2010). Subsequently, TNC and NPS devised a baiting strategy designed to eradicate Argentine ants in wildland areas with minimal non-target impacts (Boser et al. *in press*). This protocol uses an attractant (sugar, or sugar and eggs), a low concentration of active ingredient (for example, 0.0006% thiamethoxam), and small aliquot of attractive bait to achieve best results in wildland areas. The protocol was designed to be easily utilized in rough terrain, thick vegetation and over large areas.

Laboratory trials were conducted in 2010 and 2011 and field trials occurred in 2012 and 2013[1]. After extensive research and consultations with experts, several promising commercial baits were selected for their potential to control Argentine ants (Rust 2011).

In 2012 NPS and TNC initiated a small pilot study on Santa Cruz Island to test the results of the laboratory trials. The experimental objectives of the 2012 pilot study were to (1) measure the efficacy of 0.0006% and 0.0018% thiamethoxam bait in 25% sucrose solution for the control of Argentine ant populations on Santa Cruz Island and (2) determine the attraction of non-target species to the toxicant baits. To accomplish these objectives a BACI (Before-After, Control-Impact) experimental design was used to compare the Argentine ant abundance in control sites to sites treated with thiamethoxam

[1] A Research Authorization was obtained by TNC from the California Department of Pesticide Regulation authorizing the use of two low-concentration baits on Santa Cruz Island (permit no. 1204015 and 1305028). In 2012 the EPA issued a letter a exempting the project from an Experimental Use Permit (EUP) because the small extent of the 2012 project. In 2013 the EPA issued an EUP to treat 1600 acres for Argentine ants on the California Channel Islands (permit no. 89927-EUP-1) and the permit was utilized during the 2013 pilot study.

0.0006%. Two invaded treatment plots, 9.95 and 7 acres in size, and two identical paired control plots, and 379 permanent monitoring points were established and monitored monthly over the course of the experimental trial, May through October 2012.

The protocol used specially designed bait and toxicant, which had been permitted with the Environmental Protection Agency (89927-EUP-1) and the California Department of Pesticide Management (1305028), and was mixed by TNC staff on-site. The toxicant used was thiamethoxam diluted with 25% sucrose solution to 0.0006% thiamethoxam. Hygroscopic polyacrylamide beads (MiracleGro) were added to the solution and absorbed the sugar water/thiamethoxam mix. In 2012 the thiamethoxam bait was applied to the treatment plots in the first week of every month for four consecutive months (June-Sept) in bait stations and in hygroscopic beads. Bait stations filled with 300 milliliters (mL) of the thiamethoxam bait were placed in dry creek beds and strapped to trees. Hygroscopic polyacrylamide beads hydrated with the thiamethoxam/sucrose bait were only used in portions of the treatment plots that were not in the creek bed. The bait was dispersed at a rate of 4 gallons per acre in 15 ml piles on a 2 x 2 meter grid.

Three activity measures were collected in 2012 to measure the treatment efficacy for the control Argentine ant populations and detection of non-target impacts:

- Bait monitor counts
- Pitfall traps
- Instantaneous toxicant bait counts

The first pilot study resulted in a measured reduction of 99.5% in ant activity in treated areas. Some of the observed activity of ants was near the treatment boundaries and could have been as a result of re-infestation from untreated edges. NPS and TNC determined that the protocol may be effective with some small modifications and that a second pilot study was required to test these modifications.

The spatial and seasonal variability of Argentine ant dietary preferences make it advantageous to have more than one bait matrix to utilize in large scale eradication efforts. In 2012 NPS and TNC conducted small scale field testing and determined the egg/sugar and water hydrating polymer bait matrices were more attractive to Argentine ants compared to the alternative matrices. The advantages of the egg/sugar bait matrix are that it is highly attractive, it is extremely effective at killing queens (Davis et al. 1993), and it has a viscosity that enables it to stick to vegetation. The disadvantage is that it is more expensive than the sucrose bait. The advantages of the water hydrating polymer matrix are: it is attractive, relatively inexpensive, and can be easily aerially broadcast over large areas. A possible disadvantage is that some studies show that sucrose -based baits are not as effective at killing queens (Davis et al. 1993). However the pilot studies on SCI have found that most Argentine ant nests do not survive the prescribed treatment, therefore this method appears to be effective at killing queens on SCI.

In 2013 NPS and TNC conducted a second pilot study on 180 acres on (areas outlined in red in Figure 3), encompassing three entire infestations so that the effect of re- infestation from untreated areas would not confound the results. The objective of the study was to determine how an increase in the number of treatments, application rate and modifications to the distribution of the bait would affect the protocol

efficacy. The baits (described below) were deployed via hopper and helicopter to create efficacies and reduce the potential for injuries in field technicians. Bait deployment occurred every 2-3 weeks from June through November 2013, for a total of 12 deployments, and at a rate of 16 gallons of bait per acre. Use of the helicopter necessitated a scatter distribution of bait, rather than the piles that were used in 2012.

Once again, thiamethoxam was diluted with 25% sucrose solution to 0.0006% thiamethoxam. The insecticide was applied in two formulations; a) Hygroscopic polyacrylamide beads (JMR Chemical) and b) Egg/Sugar mixture. The hygroscopic polyacrylamide beads were added to the thiamethoxam and 25% sucrose solution. Thiamethoxam 0.0006% bait was applied at a rate of 16 gallons per acre. The egg/sugar mixture was prepared by mixing 25% sugar by weight with raw eggs and commercially available thiamethoxam was mixed in thoroughly to achieve consistent dilution of 0.0018%. The entire mixture was deployed as either raw sugared eggs or a homogenized half cooked and half raw sugared eggs. The egg and sugar solution was deployed by hand in small areas (>3 m^2) that were known to be used by large colonies of Argentine ants, such as oak tree trucks. The hygroscopic polyacrylamide beads were used throughout the treatment areas and deployed by hopper and helicopter and by hand in sensitive areas.

Two activity measures were collected in 2013 and 2014 to measure the treatment efficacy for the control Argentine ant populations:

- *Bait monitor counts*
- *Observer searches*

Response of Argentine ants to field trials

There was an immediate and sustained reduction in the Argentine ant abundance within the treatment plots in 2012 and 2013. After the fourth and final thiamethoxam liquid bait deployment in 2012 the abundance of Argentine ants collected was reduced in the treatment plots compared to control plots by 99.8% within bait monitors and 99.5% within pitfall traps. The final monitoring round in 2013 was conducted after eight aerial applications. No Argentine ants were detected at monitoring points and ants were detected at two locations via the searching method. After assessing the results of the last monitoring round in 2013 it was decided that the final four treatments would be administered, for a total of twelve treatments in 2013. TNC and NPS retreated the 2013 trial areas in fall 2014, in spite of the lack of detectable ants, because the drought conditions would increase the attractiveness of the hydrated bait to Argentine ants and should increase the likelihood of eliminating any remnant ants. Intensive monitoring in 2014 failed to detect any Argentine ants.

The aerial deployment of the toxicant hydroscopic polymer bait at a rate of 16 gallons per acre resulted in a quicker and more effective reduction of the Argentine ant population compared to the hand deployment of bait in discrete piles in 2012 at a rate of 4 gallons per acre. The abundance of Argentine ants collected with non-toxic baits was reduced by 99.9% after two aerial deployments in 2013, whereas the Argentine ant abundance was reduced by 65.6% after two hand deployments in 2012. The increased efficacy of the aerial bait deployment may be the result of increased bait evenness, or density.

Increasing the evenness and density of deployed bait increases the likelihood that forager ants will encounter the bait and take colony-lethal doses of bait back to their nest (Hoffman et al. 2010).

Section 2. Alternatives

Alternative A: No action

"No Action", or continuation of the status quo, involves continued efforts to detect, contain, and control Argentine ants in order to prevent their spread on the island (Table 2). No Action also includes biosecurity measures in order to minimize risk of new introductions of Argentine ants or other non-native insects. These practices are consistent with standard Integrated Pest Management (IPM) policies for the NPS.

This alternative would focus primarily on modifications of human behavior in order to minimize the human transport to Argentine Ants to new locations on the island (quarantine) and reduction of Argentine ant colony extent or density in order to minimize expansion and impacts of existing colonies. The No Action alternative includes use of low toxicity insecticide products such as Boric Acid and Botanical Oils in selected areas for control of Argentine Ants.

Table 2. No Action containment and control of Argentine Ants on Santa Cruz Island

Actions	**Actions**	**Resources**	**Timing**
Detection and Delimitation	Periodic survey of current limits of ants. Start with use areas: UCR, Navy site and vicinity, Airstrip, Prisoners, Christy, Del Norte, Main Ranch, Scorpion, Smugglers	Staff and cooperators	Ongoing
Containment	Set up Quarantine/SOPs for infested areas.	Public notices and flyers	Ongoing
	Develop and implement Biosecurity actions to ensure no additional introductions	Regulations	Ongoing
Local control	Control Argentine ants with insecticides at locations with high risk of transport to other island locations using over-the-counter insecticides such as boric acid and botanical oils	NPS and TNC staff	Ongoing

Biosecurity and prevention of new infestations

CINP and TNC have implemented measures to limit the unintentional transport of Argentine ants to and within Santa Cruz Island. Items with high potential to transport Argentine ants from the mainland to the islands (potting soil, unwashed vehicles, firewood) are not allowed to be transported to the island. Additionally, high risk materials, such as building materials and wood are not to be moved from areas on the island that are currently infested with Argentine ants. All vehicles must be power-washed before being transported from the mainland to the island. No wood, soil, or living materials may be brought to the island without prior permission from the park superintendent or the TNC manager.

However, the presence of these ants in the U.C. Reserve Field Station/Cañada del Medio/Cañada del Puerto area poses very high concerns regarding the likelihood that materials harboring ants could be moved by humans or stream flow would move ant colonies downstream. There is so much material that is being stored in this area of the island and so much movement of people and supplies in and out of the area, that it is probably only a matter of time before additional populations of Argentine ants are unintentionally created.

Control in limited locations

Sucrose solutions containing boric acid are effective at controlling workers in both the laboratory and the field, but only if the boric acid is no greater than 1% (Hooper-Bui & Rust 2000; Klotz et al. 2000a). Control may take some time – only partial control of queens was achieved in laboratory conditions when bait was available for 24 hours - so bait should be left out until no more ants are seen collecting it.

Botanical oils are another effective and low toxicity method for control of limited infestations of Argentine ants. Botanical oils, also called essential oils, are naturally produced by plants as defense against herbivory. Examples of essential oils are peppermint oil, clove oil, and citrus oils. Botanical oils need to be applied directly to colonies of Argentine ants to be effective.

Boric acid and botanical oils cannot be distributed in a manner that controls Argentine ants across the landscape in which they currently occur on Santa Cruz Island.

Alternative B: Eliminate Argentine Ants from all Locations

In addition to the "Biosecurity and Prevention of New Introductions" actions identified in Alternative A: No Action Alternative, the NPS and TNC would utilize insecticides in a liquid or gel bait that would be dispersed at sufficiently high application rate and frequency to eliminate Argentine ants from the treatment area. This alternative would apply research and trials conducted to date and build on that knowledge to develop techniques for deployment of insecticides to reach all or most of the current infestation area.

Prior to treatment, a new delimitation of the outer edges of the Argentine ant infested areas would be conducted. The delimitation would be conducted by systematically mapping infestations utilizing both visual inspections and attracting ants to baits. Detection transects spaced approximately 20m apart, running perpendicular to the known invasion boundary, will be inspected for the presence of Argentine ants. The approximate limit of the invasion would first be determined by visually inspecting for the presence of Argentine ants. The inspector would move 10m further from the assumed known boundary each time Argentine ants are detected and would go ≥ 20m from the last location ants were detected and search for 5-10 minutes before determining the absence of ants. The furthest extent of the ants would be flagged and the exact location recorded.

Once the delimitation boundary is mapped, the area would be buffered by 50 m to account for the possibility of cryptic ant nests outside the detectable boundary. The resulting area would be considered the treatment area. Monitoring points would be located at points within that treatment area. A commercially available thiamethoxam product, diluted to 0.0006% and 0.0018% thiamethoxam with 1) 25% sucrose solution, and 2) chicken eggs mixed with 25% sugar, and deployed at a maximum rate of 16

gallons per acre. The 25% sucrose and thiamethoxam solution would be deployed in hygroscopic polyacrylamide beads. This polyacrylamide structure produces adequate housing for the liquid bait, which allows it to be broadcast in small aliquots over a large area. Argentine ants are able to consume the liquid bait directly off the outside of the polyacrylamide. Alternatively, one of the other pesticides described in Appendix B may be substituted for thiamethoxam. The egg and sugar mixture contains egg mixed with 25% sugar by weight and 0.0006% thiamethoxam. The egg may be entirely raw, or 50% cooked egg and 50% raw egg. The consistency of the mixture allows it to stick to vegetation and rugged terrain, which allows for better bait coverage. These thiamethoxam baits are registered by The Nature Conservancy under an Experimental Use Permit granted by the Environmental Protection Agency (89927-EUP-1).

The baits may be deployed approximately every 2-4 weeks in May- November for a maximum of 12 treatments per year. Bait may be deployed in the treatment area using a hopper and helicopter and deployed by hand in sensitive areas. GPS navigation technology in the application helicopter would be used ensure the bait is deployed evenly within the treatment area and not outside the treatment area. The hopper is calibrated and controlled by the pilot so the maximum bait application rate is not exceeded.

The polyacrylamide bait would be deployed on the entire treatment area via helicopter or by a technician deploying bait at target locations. Originally designed as a soil amendment, the polyacrylamide would remain on the landscape and would be assimilated into the surrounding soil.

The egg and sugar bait may also be deployed. The egg and sugar mixture may be deployed via helicopters, or sprayed onto vegetation or cliff-sides by a field technician.

It is expected that the intensive treatment of the remaining known infestation of Argentine ants (approximately 1600 acres) would take place in one year. Monitoring of the treated infestation sites may occur for up to ten years after treatment begins. If remnant Argentine ant nests are found in the treatment area then field technicians would hand-deploy bait at that site up to four times to ensure that the remnant ant nest is eliminated.

Once Argentine ants are eliminated from infestation sites, the results will be permanent and no further treatment will be required. Monitoring and biosecurity will remain in place to reduce the risk of future new introductions and to detect introductions if they occur.

Labels, permits, approvals and material safety data sheets

The Environmental Protection Agency issued an Experimental Use Permit (EUP) for to use thiamethoxam to treat Argentine ants 1,600 acres of the California Channel Islands (89927-EUP-1). The US Fish and Wildlife Service was consulted regarding the Argentine ant treatment research on March 26, 2013 and NPS issued a letter of No Effect on Federally threatened or endangered species. A research authorization the Argentine ant treatment research was issued by the Department of Pesticide Regulation (DPR) to the Nature Conservancy following the restrictions outlined in the EUP (RA No. 1305028). The Country of Santa Barbara was notified of the intent to apply restricted materials on Santa Cruz Island on May 3, 2012.

Pesticide labels and material safety data sheets (MSDS) would be maintained in the TNC office on Santa Cruz Island and at the NPS headquarters in Ventura. A hard copy reference would be kept in the storage, mixing area, in project vehicles and at the sites.

Best Management Practices when using pesticides:

- All pesticides under consideration would be handled and stored in a manner to minimize any risk of accidental exposure. Only Caution labeled pesticides and adjuvants, the least toxic chemicals, would be used on this project.
- Pesticides and pesticide containers would be lawfully stored, handled, and disposed of in accordance with the label and in a manner safeguarding human health, fish, and wildlife, and prevent soil and water contamination.
- Any pesticide spills would be addressed immediately.
- Equipment and supplies used in the field would be inspected for target pests and decontaminated if necessary.
- All pesticides would be applied by or under the supervision of person(s) holding a California Pesticide Applicators License.
- Pesticides would be mixed and loaded no less than 100 feet from any above ground water sources.

Applying pesticides

- Pesticide would be applied no sooner than 48 hours pre or post a precipitation event to reduce the risk of pesticide run-off. Typically, the May to November period has little or no precipitation on Santa Cruz Island.
- Applicators would adorn personal protective equipment when mixing, loading, and applying pesticides.
- Insecticides would be deployed by helicopter in all but sensitive areas such as in riparian zones.
- Insecticides would be deployed by hand around sensitive areas and in target areas.
- Argentine ant bait stations containing liquid insecticide may be used in some sensitive areas.
- Herbicides would be applied using three-gallon backpack sprayers, one-gallon handheld pump sprayers, and/or a 100-gallon truck mounted spray rig. No herbicides would be deployed from a helicopter.
- No herbicides would be applied to open water.
- Aquatic approved herbicides would be used when working near stream courses.
- Herbicides would be applied as a foliar application, but when feasible cut-stump, drill-and-fill, or hack-and-squirt would be utilized to reduce the risk of drift and the amount of herbicide utilized in the environment.
- Herbicides would be applied when wind speeds are between 1-10 mph, which is consistent with the labeling requirements of all proposed herbicides.

Safety

Human safety is the number one priority for all activities performed by NPS and TNC. Project managers would be responsible for assuring the appropriate training and materials are made available and the on-

island crew leader would be responsible for ensuring personnel abide by all Best Management Practices, safety protocols and County, State, and Federal rules and regulations.

Personal protective equipment and training

All personnel working with pesticides would wear the specific personal protective equipment (PPE) identified on the pesticide label. The appropriate PPE would be worn at all times during handling, mixing, and applying. PPE's would include: long shirts, pants, Nitrile gloves, safety glasses, boots and socks.

Helicopter Best Management Practices

- Personnel will wear nomex flame retardant flight suits.
- Fuel will be stored in approved jet aircraft fuel totes equipped with high-grade electric fuel pumps.
- Staging and fueling areas will have a minimum of 50-foot vegetation clearance surrounding the landing zone.
- Helicopters will not hover more than two minutes at any one location except at staging areas.
- Helicopters will be equipped with fire extinguishers and first-aid kits.
- Helicopters will not fly over historic structures, groups of people, or campgrounds.
- All scheduled maintenance will be completed on time.
- All FAA rules and regulations will be strictly followed.

Alternatives Considered but Eliminated from further Study

a) Sprays or pesticides to directly kill foraging ants

Many products are available for the purpose of killing or repelling ants. These products serve primarily to limit the nuisance effect of Argentine ants in buildings or orchards. Because a very small proportion of an Argentine ant colony is foraging at any one time, contact insecticides do not control the infestation and have short-term effects. Therefore, direct killing of Argentine ants would not achieve the goal of decreasing the extent of the infestation.

b) Biological Control

Biological control refers to the use of another living organism, generally a predator, parasite, or disease, to attack and reduce the pest population. In South America, where Argentine ants originated, they are not considered a pest and they have natural predators, parasites and competitors.

There are no biological control agents for Argentine ants that are approved for importation to the United States. Because of the potential for a biological control agent to reproduce, spread, and negatively affect non-target species, there is a considerable amount of research that is required to develop this potential.

c) Manual distribution of toxicants by personnel on the ground

Manual distribution of bait by personnel was tested in the initial field trials. This method was overly time-consuming, even for the accessible and relatively small areas that were treated in the field trials. The method cannot be scaled up to the size, or the rugged terrain, of the largest infestation area which is the primary focus of future treatments. Personnel on the ground will be utilized to monitor treated areas and for follow-up treatment of limited areas.

The Environmentally Preferred Alternative

Alternative B – Eliminate Argentine Ants from all locations

The environmentally preferred alternative is Alternative B – Eliminate Argentine Ants from all locations. Under Alternative B, NPS and TNC would deploy toxicant bait throughout delimited infestation areas that still have Argentine ants with the goal of controlling or eliminating Argentine ants.

Section 3. Affected Environment

Santa Cruz Island is the largest of the Channel Islands off the coast of Southern California. It is home to a variety of wildlife including a significant number of plants and animals found nowhere else in the world, making Santa Cruz Island a concentration site for biological diversity. In addition, an estimated 3,000 archeological sites associated with the Chumash culture are located on Santa Cruz Island. Ninety percent of the island is listed in the National Register of Historic Places for its archeological significance. Channel Islands National Park was established to protect and restore these nationally significant resources.

Physical Setting

The five northern Channel Islands and surrounding one nautical mile of water are within Channel Islands National Park. The largest of the Channel Islands, and one of the islands within the national park, is the 62,000 acre Santa Cruz Island. Santa Cruz is twenty-four miles long, and its width ranges from two miles across at the isthmus to 6.5 miles across through its great Central Valley. Santa Cruz Island, in the Santa Barbara Channel, is 19 miles from the nearest mainland point and southwest from the city of Ventura, California.

The topography of Santa Cruz Island is dominated by two east-west mountain ranges flanking the fault-dominated Central Valley. The Central Valley divides the island into two very different geologic terrains: to the north, a purple-brown ridge of young volcanic rocks rises to Mt. Diablo and then plunges abruptly into the Santa Barbara Channel. At almost 2,500 feet in elevation, Mt. Diablo is the highest point on all the Channel Islands. South of the Central Valley a weathered ridge of reddish metamorphic rocks reaches an elevation of about 1,500 feet. At seaward base of this ridge a submerged shelf extends several miles southward before falling off into the Santa Cruz Basin, which is more than a mile deep.

Santa Cruz Island was never connected to the mainland. Scientists believe most plants and animals reached the island by chance after swimming, flying, or floating on debris, especially during periods of low sea level. Considering that it was colonized by overwater dispersal, Santa Cruz Island supports a remarkably rich biota.

Weather

The Channel Islands exhibit the Mediterranean climate typical of the central and southern California coasts. Precipitation patterns exhibit strong seasonal trends, with heavy rainfall between November to March, and seasonal drought between late May and October when a stable high-pressure system settles off the coast. A shallow coastal marine layer raises atmospheric humidity, frequently visible as fog, and helps to lessen the impact of the summer drought conditions on the islands. Moisture from fog accumulates on vegetation and falls as fog-drip precipitation - which is a significant source of summer soil moisture.

The longest continuous weather record on Santa Cruz Island comes from the Central Valley. Records from this weather station document amounts of rainfall at the Main Ranch since 1904. The average annual precipitation at the gauge between 1904 and 1993 is 19.9 inches, however there is high variability between years. As of 2014, there have been three years of very low precipitation. Average maximum monthly temperatures in the Central Valley range from 59.8º F in January to 75.7º F in September, while average minimum monthly temperatures range from 39.3º F in January to 52.2º F in August, for temperatures recorded between 1948 and 2007.

History of Human Use of Santa Cruz Island

Santa Cruz Island seems to have supported a large human population during most of prehistory. Recent archeological research on Santa Cruz Island shows evidence of human occupation 8,900 years ago, and the potential for even older material exists. Eleven historic Chumash villages are known for Santa Cruz Island. Earlier sites, ranging from only a few meters square to extensive shell mounds covering hundreds of square meters, are found along the coastline and in the interior. The Chumash were removed from the island by the 1820s.

In 1839, the Mexican government granted title to the island to Andres Castillero, who became the first private owner of Santa Cruz Island. This was the start of the ranching era, wherein sheep, horses, cattle and hogs were cultivated by various owners until the late 20th century.

In 1978, the Nature Conservancy purchased 90% of the island and acquired control of the property in 1987. The eastern 10% end of the island remained a working ranch until NPS took ownership of that land in 1997. By the year 2000, NPS and TNC shared ownership of the island and all feral ungulates had been removed in eradication efforts.

The ranching and agricultural resources form a historic period cultural landscape over much of the island. The main ranch in the Central Valley is the largest and most significant of the ranch complexes. Currently there are four commonly used housing facilities on the island and two infrequently used facilities can accommodate up to 80 people. There are two campgrounds that host temporary visitors.

Biological Resources

Santa Cruz Island harbors several species that are endemic to the island or the Channel Islands, including 1 amphibian, 2 reptile, 4 terrestrial mammals, and 10 landbird species. Santa Cruz Island supports fewer animal species than mainland areas of comparable size, because only a subset of the mainland fauna

successfully colonized the island. However, the island's isolation from mainland populations created a fauna that includes many species only found on the Channel Islands or only on Santa Cruz Island. In general, island fauna are species-poor, because the low frequency of colonization of islands by either a breeding pair or gravid female. In addition, island animal species are at high risk of extinction relative to their mainland cousins because small founder populations can result in poor genetic resilience, and because natural and anthropogenic disturbances can cause high rates of mortality within small and localized populations.

Vertebrates

Being the most topographically and ecologically diverse of the park islands, Santa Cruz has a greater diversity of breeding landbirds than the other islands. Seventy species of landbird are known to breed on Santa Cruz Island (Collins 2011), and dozens more visit the island to forage or rest on migratory journeys. Eight of island-breeding birds are subspecies endemic to two or more of the Northern Channel Islands, while one bird - the Island scrub-jay (*Aphelocoma insularis*) - is endemic to Santa Cruz Island. Two of the endemic subspecies (horned lark and loggerhead shrike) exist at low population levels. Fifteen active territories of peregrine falcons were located on the island in 2014 (Sharpe pers comm). Extensive riparian areas, oak woodlands, chaparral, and pine forests provide habitat for acorn woodpeckers, red-breasted nuthatches, northern flickers, and the endemic island scrub-jay, as well as pacific-slope flycatchers, black phoebes, and spotted towhees.

Five reptile and three amphibian species have been recorded on Santa Cruz Island. The Channel Islands slender salamander (*Batrachoseps pacificus pacificus*) and the island fence lizard (*Sceloorus occidentalis beckii*) are endemic to the Channel Islands. The Santa Cruz gopher snake (*Pituophis catenifer pumilus*) and Baja California tree frog occur only on Santa Cruz and Santa Rosa. The yellow-bellied racer and the black-belly slender salamander only occur on Santa Cruz. These animals occur in scattered areas and in limited numbers on the islands**.** The salamanders should be found in many habitats. Very little is known about the snake.

Fifteen mammal species are known to live on the island, giving this island the distinction of being the richest island in wildlife diversity of the northern Channel Islands. The deer mouse is the most common mammal species. Bat surveys conducted on the Channel Islands have detected the presence of eleven species of bats in the park (von Bloeker 1967; Brown 1980; Brown et al. 1994).

Three mammal subspecies occur only on Santa Cruz Island—Santa Cruz island deer mouse, Santa Cruz island harvest mouse, and Santa Cruz island fox. Widespread small mammal monitoring has not been conducted on Santa Cruz Island, although endemic deer mice (*Peromyscus maniculatus santacruzae*) would predictably be found in all habitat types on the island.

The island spotted skunk is only present on Santa Cruz and Santa Rosa islands. (It once occurred on San Miguel Island, but was extirpated from that island.) The skunks are nocturnal carnivores, preferring ravines, and to a lesser extent chaparral and grasslands.

The creek through Cañada del Medio and Cañada del Puerto flows intermittently during the winter and spring rainy season, then slowly disappears during the dry summer months. There are no known permanent fish species in the creeks of Santa Cruz Island.

Invertebrates

Like all of the Channel Islands, the invertebrate fauna of Santa Cruz Island is not well studied. Of about 750 species of lepidopterans (butterflies and moths) known on the Channel Islands, about 550 of species were reported on Santa Cruz. Fourteen of these species were endemic to one or more of the Channel Islands. Powell (1994) estimated that about 70-75% of the butterfly and moth species of the island are known to science - 550 lepidopteron species have been observed on Santa Cruz Island. Three Lepidoptera are endemic to Santa Cruz Island, *Acrocercops insulariella*, Ephysteris *sp.* and *Chlodes sylvanoides subsp. santacruza* (Powell 1994).

The native bee fauna is more diverse on this island than on the other Channel Islands due to the island's size, elevations, topographical diversity, and habitat variability (Wenner and Thorpe 1993). The native bee fauna of Santa Cruz Island is well known, due to research on the effects of non-native European honeybee (*Apis mellfera*) on native bees (Wenner and Thorpe 1993). Most native bees are solitary, not social like their cousins the European honeybees. European honeybees were entirely removed from the island by 2004.

As with the other fauna on Santa Cruz Island, the aquatic insect assemblage within the streams on the island, including Cañada del Puerto, is depauperate as compared with mainland habitats (Furlong 1999). The island supports a greater than expected abundance of flies (Order: Diptera) and beetles (Order: Coleoptera) with aquatic larval stages, and an underrepresentation of caddisflies (Order: Trichoptera) and stoneflies (Order: Plecoptera). This discrepancy may be due to greater dispersal ability of flies and beetles relative to caddisflies and stoneflies, or may reflect the ability of flies and beetles to adapt to more floodprone and less-shaded stream channels as are found on Santa Cruz Island relative to the rest of Santa Barbara County.

Vegetation

Vegetation communities on Santa Cruz Island, like those on the other Channel Islands, developed in relative isolation from the mainland. Although many species on the islands are the same as those found on the mainland, almost 50 species are endemic to the Channel Islands or even to a subset of the Channel Islands. Some endemic island species are the only remaining populations of taxa that were once widespread on the mainland; others evolved into unique species on the Channel Islands - descendants of mainland species that colonized the islands and then adapted to local conditions through speciation. Santa Cruz Island vegetation communities developed without human influence from the end of the Pleistocene approximately 12,500 years ago until the first sizable human settlements on the islands about 7,000 years ago.

Native American settlers on the islands may have influenced these vegetation communities with food gathering activities, harvest of vegetation for building materials, promotion of economically important plants, intensification of fires, and possible introduction of mainland plants and animals. About 150

years ago, people of European descent introduced domestic and feral animals to the island. In addition, these most-recent settlers on Santa Cruz Island engaged in cultivation within the Project Area, and introduced numerous alien plant taxa – both purposefully and unintentionally. These actions disrupted the composition and distribution of the island's vegetation, and severely altered natural soil and hydrologic processes on the islands.

Cessation of agricultural and commercial grazing in the second-half of the 20th century, and removal of feral pigs from the island in 2006 have allowed for some recovery of native plant communities. However, ongoing damage to vegetation communities from historic sheep and cattle grazing, pig rooting, and invasive plants are evident across the island. Forest communities on the island are drought-adapted and generally support a heavy representation of hard-leaved evergreen woody plants such as ironwood (*Lyanothamnus floribundus*), Island cherry (*Prunus illcifolia ssp. lyonii*), live oaks (*Quercus agrifolia, Q. tomentella*, and *Q. chrysolepis*), manzanita (*Arctostaphylus insularis*), and toyon (*Heteromoles arbutifolia*). Bishop pine (*Pinus muricata*) is the only native conifer on the island; on Santa Cruz Island they generally occur with an understory of broadleaved evergreen trees. Other stands of conifers on the island consist of non-native Italian stone pine (*Pinus pinea*) or Monterey cypress (*Cupressus macrocarpa*).

Deciduous tree forests are limited to canyons with permanent surface or near-surface water and are dominated by either big leaf maple (*Acer macrophyllum*) or cottonwood (*Populus fremontii* and *P. balsamifera*). Shrub communities on the island similarly support a preponderance of drought-tolerant, hard-leaved evergreen woody species. The island supports a high diversity of upland shrub communities, including stands dominated by manzanitas (*Arctostaphylus viridissima, A. insluaris,* and *A. tomentosa*), chamise (*Adenostoma faciculatum*), ceanothus (*Ceanothus megacarpus* and *C. arborus*), and scrub oaks (*Quercus pacifica*).

Federal Threatened, Endangered, and Candidate Species

There are 11 species on Santa Cruz Island that have formal status under the federal Endangered Species Act. Only two of these species, Santa Cruz Island fox and the Santa Cruz Island bush mallow, occurs in the areas that would be directly affected by this project. Only the federal listed species that occur in the project area will be individually described and evaluated for potential impacts from the proposed action (Table 3).

Table 3. Federal listed species on Santa Cruz Island

Scientific Name	Common Name	ESA Status	Occur in project area
Charadrius nivosus	Western Snowy Plover	T	No
Urocyon littoralis cruzae	**Santa Cruz Island fox**	**E**	**Yes**
Berberis pinnata ssp. Insularis	Island barberry	E	No
Boechera hoffmannii	Hoffmann's rock-cress	E	No

Scientific Name	Common Name	ESA Status	Occur in project area
Dudleya nesiotica	Santa Cruz Island Live-Forever	T	No
Galium buxifolium	Box-leaved bedstraw	E	No
Helianthemum greenei	Island rush-rose	T	No
Malacothamnus fasciculatus ssp. nesioticus	**Santa Cruz Island Bush Mallow**	**E**	**Yes**
Malacothrix indecora	Santa Cruz Island malacothrix	E	No
Malacothrix squalid	Island malacothrix	E	No
Thysanocarpus conchuliferus	Santa Cruz Island lacepod	E	No

Legend
E = Endangered
T = Threatened
SCC = Species of special concern
N/A = Not listed
Species in bold occur in the project area

Federally listed species in the project area

Santa Cruz Island fox

The island fox (*Urocyon littoralis*) is the largest of the Channel Islands' native mammals. A descendent of the mainland gray fox, the island fox evolved into a unique species over 7,000 years ago. The island fox has similar markings to its ancestor, but is one-third smaller. Environmental and ecological factors such as drought or food scarcity may have contributed to the natural selection for a smaller size. At 12 to 13 inches in height and 4 to 5 pounds, the island fox is about the size of a housecat. Island foxes have gray coloring on the back, rust coloring on the sides, and white underneath. The face has distinctive black, white, and rufous-colored patterns.

Island foxes are distributed as six different subspecies, one on each of the six Channel Islands on which they occur. Each population is small, ranging from less than a few hundred to a few thousand individual animals. Foxes from separate islands are still capable of interbreeding, but are physically and genetically distinct enough to be recognized as separate subspecies. Subspecies are named for their island of origin. The subspecies endemic to Santa Cruz Island is *U. littoralis santacruzae*.

The subspecies was listed as a threatened species under the California Endangered Species Act in 1987 and endangered under the federal Endangered Species Act in 2004. Island foxes occur in virtually every habitat on the Channel Islands, and forage for a wide variety of prey (Moore and Collins 1995), including mice, ground-nesting birds, arthropods, and fruits. Fox home range size varies by habitat type, season,

and gender of the animal (Laughrin 1977; Crooks and Van Vuren 1995; Thompson et al. 1998; Roemer 1999).

The fox population on Santa Cruz Island declined disastrously in the late 1990s from an estimated 2,000 individuals on the island in 1994 to perhaps less than 135 animals in 2000 (Roemer 1999). This decline was probably due to predation by golden eagles *(Aquila chrysaetos*) (Roemer 1999; Coonan et al. 2010) which were unnaturally sustained on the island by non-native feral pigs. Removal of golden eagles and elimination of feral pigs from the island and a successful fox captive breeding and reintroduction program is resulting in recovery the Santa Cruz Island fox population. About 1,200 foxes inhabit the island today, and their population is increasing (Boser, pers comm. 2014).

Santa Cruz Island Bush Mallow

This is a federally listed plant (US Fish and Wildlife Service 2000). There are 2 outplanting sites of Santa Cruz Island bush mallow in the treatment areas, one in the UC Reserve area and one in the Valley infested zone. It is not expected that this project would impact those plants. The outplantings are clearly marked so they would not be trampled. The pesticide does not affect plants.

State-listed or endemic species in the project area

Island Spotted skunk

The Island Spotted Skunk is a state-listed speciesfound on Santa Cruz and Santa Rosa Island. The skunk is primarily nocturnal and carnivorous, consuming mice and insects. The skunk listed as a state threatened species due to its restrained island range, small population size and habitat degradation due to historic ranching activities. Competition with island foxes is thought to limit spotted skunk numbers on both islands (Crooks 1994).

Island scrub-jay

The Island scrub-jay is found only on Santa Cruz Island. The primary habitats for this species are oak woodland, pine woodland, and chaparral. There are estimated to be approximately 2,000 individuals of this species (Sillett et al. 2012). The Island Scrub Jay occurred in the past on Santa Rosa and San Miguel Islands. The cause and date of extirpation is not known.

Lotus argophyllus

Lotus argophyllus is a state listed plant. It is scattered throughout the Cañada del Medio and Cañada del Puerto streambed mainly on the gravelly materials in the streambed itself. It is usually smaller than knee-high, and grows low to the ground in a roundish tuft that can get as big around as 1-2 feet. It has small leaves covered with silky silver hairs and small snapdragon shaped yellow flowers in clusters.

Wilderness Eligibility

A portion of the project area, the land which is owned by NPS, has been determined to be eligible for designation as Wilderness. The entire 40 acre Blue Site is on federal land and is eligible for Wilderness designation. Approximately 500 acres of the 1,600 acre Valley site is eligible for Wilderness designation.

Most of this project takes place on land owned by TNC. The portion of the project area which is owned by TNC is not eligible for Wilderness designation because the land is in private ownership.

Section 4. Environmental Consequences

The intent of the National Environmental Policy Act (NEPA) is to establish opportunities for the interested public to learn of projects under consideration by federal or state agencies. Additionally, NEPA ensures that agency decision makers are provided with an analysis of the likely environmental impacts of alternative methods of achieving agency goals.

Internal scoping was conducted to identify the natural resources that could potentially be affected by the project and assess likelihood of exposure to bait, toxicant, or project impacts (Table 4).

Table 4. Terrestrial Vertebrates discussed for impact analysis during internal scoping

Species & Status	Relevant Life-History Characteristics and Dietary Preference Relevant to Exposure	Likelihood of exposure
Amphibians		
Baja California Tree-frog	Breeds in early spring. Diet: insects such as mosquitoes and flies with most active prey eaten more frequently.	Low
Slender and Black Bellied Salamander	Breeds in early spring. Diet: insects, such as mites and spiders.	Low
Birds		
Common Raven	Breeds in early spring. Diet: insects, seeds and fruits. Some evidence they are feeding on bait. (Observations include 1 day observed feeding on bait in 45 days of bird-watching in treated areas.)	Low
Island Scrub-jay	Breeds in early spring. Diet: insects, seeds and fruits. No evidence they are feeding on bait. (Observations include 45 days of bird-watching in treated areas.)	Low
Song Sparrow	Breeds in early spring. Diet: insects, seeds and fruits. No evidence they are feeding on bait. (Observations include 45 days of bird-watching in treated areas.)	Very low
Mammals		
Island fox Federally endangered	Breeds in early spring. Diet: mice, insects, seeds and fruits. Observed feeding on the bait during multiple occasions. Seven of the nine animals trapped at the TNC ranch prior to the 2013 baiting season, were trapped at the end of the baiting season. The recaptured individuals did not sustain weight loss or show any other	Moderate

	observable effects of consuming the bait.	
Santa Cruz island deer mouse	Breed several times during the year. Diet: Seeds and insects No evidence they are feeding on bait. (Observations: 60 nights of camera trapping.)	Low
Island skunk	Breed in early spring Diet: Primarily mice and insects No evidence they are feeding on bait. (Observations: 60 nights of camera trapping.)	Low

Impact Topics Dismissed from Further Analysis

Aesthetics

No aesthetics or scenic vistas would be affected by actions to control infestations of ants. Restoration activities would be temporary, and project sites are remote and would be limited to relatively small infestations of ants, and the majority of the project occurs in areas restricted to visitation.

Air Quality

Implementation either proposed alternative would result in short-term temporary exhaust emissions and fugitive dust generated by motor vehicles (for both the transport of the workforce needed for implementation of the project and helicopter trips to remote project sites). The proposed project would be implemented for a short period of time and use 1-3 vehicles, thus there would be no impact to air quality.

Cultural Resources

The project area does not contain buildings of cultural significance. The only buildings encompassed in the project area are the University of California Santa Barbara Field Station Buildings and Directors House. Other cultural resources on the island include artifacts located on the soil's surface or buried in the soil, which could be impacted during ground disturbing activities. This project deploys bait on the surface of the ground and does not use ground disturbing techniques. It is not expected that these cultural resources would be at all impacted by the project.

Marine Mammals

In 2013 TNC and NPS conducted marine mammal surveys each week to record the number of marine mammals on the coast near the infestations area. Based on these surveys, it is expected that few to no marine mammals will be present in or near the project sites during the project. Therefore no impacts to marine mammals are expected under either alternative.

Seabirds

NPS had mapped locations of nesting seabird colonies. None of these colonies fall within the project area. Therefore no impacts to seabirds are expected under either alternative at this time. However, if Argentine ant populations continue their range expansion under alternative 1, they may eventually negatively impact sea bird colonies and nestlings. The project seeks to remove Argentine ants from SCI before they spread and negatively impact the island environment and sensitive seabird species (Chalcraft and Andrews 1999, Banko et al. 2002, Choe et al. 2010).

Health and Safety

No impacts to health and safely are expected under either alternative. When working with pesticides we would implement Best Management Practices (described in Chapter 2) which would reduce the risks associated with pesticide use.

Noise

The proposed project would not expose persons to or generate excessive vibration or noise levels. The project would primarily involve temporary noise sources associated with ground-based and aerial transport and application activities. At the most, one to two trucks and a helicopter would be used. Only one to five individuals participating in the restoration activities would be exposed to heightened noise levels at any one time. It is not expected that park visitors would be close enough to the restoration activities to be affected by increased noise levels.

Alternative A: No Action

Alternative A would result in the continued presence of Argentine ants on Santa Cruz Island, and continued expansion of Argentine ant colonies. Argentine ant nests can spread up to 100 m per year. Rainfall can move colonies a substantial distance and there is a great deal of human activity at the UC Reserve site thus it is inevitable that accidental movement of colonies will occur and Argentine ants will become established in new areas of Santa Cruz Island.

It can be expected that Argentine ants would eventually occupy all of Santa Cruz Island. The consequences of allowing unrestricted occupation of Santa Cruz Island by Argentine ants include:

a) Elimination of native ants and other invertebrates from large portions of the island
b) Possible impacts to native vegetation from reduced seed production, distribution and burial
c) Impacts to land and sea birds, particularly nestlings
d) Pest in housing and kitchens
e) There is good evidence that Argentine ant "density is negatively associated with capture rates of lizards and salamanders". ("Sampling Design Optimization and Establishment of Baselines for Herpetofauna Arrays at the Point Loma Ecological Reserve". A report prepared for Cabrillo National Monument by the USGS Western Ecological Research Center.)

NPS and TNC would take limited action to control the spread of Argentine ants. The primary tools used would be Biosecurity, Boric Acid, and Botanical Oils.

Biosecurity could avoid new introductions of Argentine ants (and other non-native species) and the human-assisted spread of already-present Argentine ants to new locations on the island. However, biosecurity will not prevent the natural spread of Argentine ants from their current infestation sites.

Boric Acid and Botanical Oils are available over-the-counter and have very low toxicity, ecological effect, and efficacy (Tables 5 and 6).

Table 5. Summary toxicological information based on MSDS

	Boric Acid	**Botanical Oils**
Ingestion	Slightly hazardous	Slightly hazardous
Dermal	Irritant	Irritant
Inhalation	Irritant	Irritant
Human Carcinogen	Group E – not considered a human carcinogen	Not available
Mode of action	Internal distress	Not available
Trade names	Gourmet Liquid Ant Bait	Nature's Wisdom Orange Oil Concentrate
Manufacturer	Innovative Pest Control Products	Nature's Wisdom

Table 6. Summary ecological and ecotoxicological Information (based on MSDS)

	Boric acid	**Botanical Oils**
Summary	Naturally occurs in air, water, soil, plants.	Naturally occurs in oranges
Chemical type	Disodium octaborate tetrahydrate	Orange Oil, Sweet
Eco-acute toxicity	Practically nontoxic to fish and aquatic invertebrates. Boric acid has a low bioaccumulation potential. Partially nontoxic to birds. May adversely affect development of young birds. Relatively nontoxic to bees.	Acute oral toxicity to rats.
Persistence	Stable under normal temperatures	Not stable in the

		environment
EPA Toxicity Category Oral	Low	None established
EPA Toxicity Category Dermal	Low	None established
EPA Toxicity Category Inhalation	Low	None established

Invertebrates

Argentine ants are known to have harmful impacts on populations of native ants and other insects elsewhere in Southern California where they have been studied and in other parts of the world where they have invaded. Following Argentine ant invasions there are typically losses of medium- and large-bodied ants, and a resulting loss of variation in dietary specialization, behavioral repertoires and nest architecture all of which are important to other plant and animal species. Losses of native ants affect animals that prey on native ants (e.g. flickers) and disrupt ant/plant interactions such as seed dispersal by harvester ants. There is no reason to suppose that Argentine ants would not cause these impacts on Santa Cruz Island if they are not managed and allowed to spread.

Native ants that would be threatened if Argentine ants are not managed and allowed to spread include *Pogonomyrmex californicus* (harvester ants which collect and store seeds) and *Messor chamberlini*, a species which is rare and very narrowly distributed on the California mainland. Most collection records of this species are from Santa Cruz Island. Additionally, only three species of native ants occur where Argentine ants have infested, thus at least 30 species of native ants are likely to be eliminated if Argentine ants persist on Santa Cruz Island.

Terrestrial Wildlife

Wildlife may be negatively affected by the continued presence of Argentine ants in Alternative A. Argentine ants have been shown to reduce seed production in native plant species studied (Hanna et al. *in press*). Therefore over time, Argentine ant presence could negatively alter habitat quality for terrestrial wildlife.

Threatened and Endangered Species

Wildlife and plant species may be negatively affected by the continued presence of Argentine ants in Alternative A. Argentine ants have been shown to reduce seed production in native plant species studied (Hanna et al. *in press*). Over time, Argentine ant presence could negatively alter habitat quality for wildlife and plant species, especially those that are already imperiled.

Water Quality
Under Alternative A, no changes to freshwater or marine water quality would be expected on Santa Cruz Island.

Water Quantity
Under Alternative A, no changes to freshwater quantity would be expected on Santa Cruz Island.

Vegetation
Under Alternative A, natural vegetation may be adversely impacted by the continued presence of Argentine ants. Argentine ants have been shown to reduce pollination and thus seed production in native plant species studied (Hanna et al. *in press*). Argentine ant abundances are high in non-native invasive fennel and Argentine ants may spread this weed as they expand their territory.

Visitor Use and Experience
Visitor experience may be negatively affected by the continued presence of Argentine ants. These ants are a pest in urban dwellings as they tend to swarm food items and water. They exhibit this same behavior in wildland areas, swarming gear and supplies and disrupting the visitor experience. If no control action is taken against Argentine ants, they will eventually infest the entire island, and thus all visitor use areas.

Effects on Wilderness Eligibility
The "No action" alternative would have no effect on Wilderness eligibility. No action would continue a situation of reduced natural character of the Wilderness. Continued spread of Argentine ants would expand the lands which are biologically impacted by the Argentine ants and would expand the degradation of natural character.

Cumulative Impacts
No cumulative impacts are expected under Alternative A.

Alternative B. Eliminate Argentine ants from all locations
The elimination of most native ants following Argentine ant invasion, coupled with this invader's aggressive behavior, generalist diet and hyper abundance, has a variety of direct and indirect effects on other types of insects and invertebrates, and even on native plants and vertebrate animals (Holway et al. 2002). Argentine ant invasions alter the composition, biomass, and trophic structure of arthropod assemblages (Krushelnycky and Gillespie 2008), interfere with the pollination and seed dispersal of plants (Carney et al. 2003, Lach 2008, Hanna et al. 2013), and can cause nest failure in some bird species (Chalcraft and Andrews 1999, Banko et al. 2002).

Native island wildlife are generally range-restricted and considered more vulnerable to competition and predation by introduced species, such as the Argentine ant (Elton 1958, Millberg and Tyrberg 1993, Owens and Bennett 2000, Delaney and Wayne 2005). Therefore a chief concern stemming from the Argentine ant invasion on SCI is the potential for endemic species endangerment or local extirpation. A secondary concern is the in-direct risks of dispersal to neighboring islands through human-mediated dispersal.

Argentine ants are already impacting some native species of Santa Cruz Island, such as native ants and native plant species (Hanna et al, *in press*), in the areas where the Argentine ants currently occur. Argentine ants are particularly damaging to native ant populations, as well as to some other invertebrates. Studies in coastal California, near Davis, California and on SCI itself all demonstrate that most other species of native ants disappear entirely from areas infested with Argentine ants. Santa Cruz Island has a rich native ant fauna with over 30 native species, including many such as the harvester ants that play important roles in the island's natural communities. Studies demonstrate that all but two or three of these species that live in the plant litter layer are seldom seen, and disappear from Argentine ant infested areas on SCI (Holway and Hanna 2011). Aggressive Argentine ants reduce pollination of the native island morning glory by deterring pollinating species from visiting the flowers while being unable to pollinate the flowers themselves (Hanna et al. *in press*).The Argentine ants are spreading at a rate of 10-100 m each year (Boser 2011). Assuming that the Argentine ants would continue to spread on Santa Cruz Island, we project that their impacts to native species would increase over time. The control or elimination of Argentine ants on SCI would reduce or eliminate the harmful effects of Argentine ants on native island species, and prevent the spreading Argentine ants from harming currently uninfested areas of the island and the species that inhabit those locations. This alternative would also reduce the likelihood that Argentine ants would impact land and seabird nestlings.

Resources currently at risk on Santa Cruz Island include a number of endemic insect species (Ward 2005; Wetterer et al. 2000) and 140 species of landbirds, 10 of which are endemic to the island or to the Channel Islands. While Argentine ant currently do not inhabit nesting locations of sensitive seabird species, such as the Ashy storm -petrel and Scripps's murrelet, if left uncontrolled the Argentine ants could spread to those locations and could severely impact the reproductive success of those species (Chalcraft and Andrews 1999, Banko et al. 2002).

Non-Target Toxicity and Impacts

The rapid attraction to, and minimal concentration of, toxicant bait needed to effectively control and possibly eradicate Argentine ant populations reduces non-target exposure. Argentine ants were observed visiting the toxicant bait within minutes of bait deployment and their visitation rate gradually decreased until ~ 48 hours after bait deployment. The restricted longevity of the toxicant bait (< 60 hours) maximizes the Argentine ant visitation per unit time and minimizes the non-target impact because the presence of Argentine ants on the baits is a deterrent to visits from non-target arthropods. The impact of the toxicant bait on the most prevalent non-target group, native ants, are further reduced when Argentine ants are present because of the homogenization of ant assemblages and reduction in native ant abundance following the invasion of Argentine ants.

The following aspects of the bait were carefully contrived to reduce the likelihood that these baits would have non-target impacts:

- The low toxicity of the thiamethoxam bait, 0.0006% was designed to reduce the impact to a species if it did consume the bait. For instance, a 0.8 kg fox pup would need to consume 144 gallons of bait to reach LD50 levels.

- The polyacrylamide beads containing the liquid bait allows very little liquid (and therefore the toxicant) to contact the soil and thus potentially leech into the soil. Unlike liquid baits that are applied on the mainland, in vegetated areas this bait will often rest on vegetation, not soil, for the 24-28 hours it needs to dehydrate, which further reduces the amount of toxicant that comes into contact with soil. In 24-28 hours the polyacrylamide dehydrates and most of the toxicant is still contained in the polyacrylamide, where it will break down over 6 weeks to 9 months.
- The bait is liquid, but not sprayed on vegetation the way that liquid baits are sprayed on the mainland. Therefore it is unlikely that the pesticide would come in direct contact with flowers or pollen.
- The clear, colorless polyacrylamide is not attractive to pollinators or other species. The small size of the polyacrylamide makes it difficult to find in areas with vegetation. In areas without vegetation it is easier to find, but still not attractive in color and therefore pollinators and birds do not appear to be attracted to it. (See non-target monitoring results, next section.)
- The egg and sugar bait is more attractive to non-target species than the polyacrylamide bait, therefore it would only be used in limited areas where the efficacy of the polyacrylamide is observed to be lower such as in oak trees where Argentine ant nest size is very large.

Invertebrates

The non-target effects associated with the Argentine ant treatment were determined to be minimal and restricted to arthropods. In 2012 we conducted 3,267 instantaneous toxicant bait counts, wherein we looked at bait and recorded the species that visited the bait. In total, 94.1% of the individuals observed during these observations were ants. The remaining 5.9% consisted mainly of Isopods and other highly abundant and non-sensitive arthropods. No members of the family Apidae (bees) were observed on the baits. The Argentine ant was the most abundant visitor. When Argentine ants were present on the toxicant bait significantly less non-target species visited the bait compared to when Argentine ants were absent. Consequently, the visitation rate of non-target species was hypothesized to increase with subsequent treatments because of the decreased visitation rate of Argentine ants, however similar to Argentine ants the non-target visitation rates decreased with each toxicant bait deployment.

The majority of the non-target impacts on native ants, the most abundant non-target group, occurred in locations Argentine ants were absent (primarily the treated “buffer zones”). Argentine ants represented 50.0% of the ants observed visiting the bait and seven native ant species accounted for the remaining 50.0%. Native ants were significantly more abundant in pitfall traps on the edge of the treatment area compared to the interior section. In total, 82.0% of the native ants collected in pitfall traps occurred along the treatment edge where Argentine ants were absent. When a buffer was established around the treatment plots, to limit the monitoring points where Argentine ants were present, the Argentine ants represented 79.0% and three native ant species of ants represented 18.9% of all visitors.

No bees were observed visiting the polyacrylamide bait. After toxicant bait deployment the abundance and diversity of native bee species was significantly higher in treatment plots compared to untreated, infested control plots, indicating that native bees may have been returning to previously infested areas after aggressive Argentine ants were removed. The impact of the toxicant bait on non-target organisms (with the exception of social insects) compared with Argentine ants is further differentiated at the

population level because the impact of the toxicant bait is limited to the solitary individuals who visit the bait, whereas the Argentine ant foragers carry bait back to their colonies and further transmit the effects.

Most native bee species on SCI are solitary, not social like European honeybees. The minimal visitation of a few highly abundant non-target taxa was the only adverse effect of the toxicant bait on the environment observed. All of these taxa were recorded in the treatment areas during treatment and 1-year after treatment occurred. No population level effects were observed on non-target invertebrates. It is expected that impacts to non-target invertebrates would be minor.

Neonicotinoids and impacts to pollinators

Some of the pesticides being considered for use and those used in pilot studies are in the neonicotinoid class of pesticides. These pesticides have received attention for having non-target impacts, especially to pollinators, such as the European honeybee. (The European honeybee, a non-native species, is not present on Santa Cruz Island). Further, unlike the European honeybee, most bees on Santa Cruz Island are solitary and do not share resources among nest mates. Therefore transmission of food or pesticide among individuals of these species would be significantly reduced when compared to the hives of European honeybees.

Terrestrial Wildlife

NPS and TNC have documented the presence or absence of target and non-target species during 852 instantaneous counts in 2013, and 3496 instantaneous counts in 2012. No interaction between terrestrial species and the bait was documented (except island fox, as discussed in a following section). Bait deployment via helicopter limits the need for technicians to hike into affected areas to treat those areas, thus eliminating disturbance to terrestrial species. Some disturbance is anticipated when technicians hike into treatment areas to monitor those areas. It is also possible that some wildlife would be temporarily disturbed by the helicopter or by the bait dropping. We considered the potential for the bait to physically impact nestling birds. However, because nests are generally hidden and within vegetation, any falling bait would initially be intercepted by vegetation or other covering materials. It is expected that impacts to terrestrial wildlife would be negligible. The helicopter noise would be brief, and the bait balls weigh approximately 1 gram, which is about the weight of an acorn or other natural debris that may typically drop on the island.

Threatened and Endangered Species

The federally or state listed threatened and endangered species that have the potential to occur in the project area are the Santa Cruz island fox, island spotted skunk, Santa Cruz Island silver lotus, and Santa Cruz Island bush mallow. The island fox is the only threatened or endangered species that has been documented to be interacting with this project. It is expected that impacts to threatened or endangered species would be negligible.

Island Fox

Camera monitoring and box trapping was used to document the effects of the ant treatment on the endangered species, the island fox. Island foxes do ingest the bait; however field trials and monitoring

of island foxes have not documented any effects. We attempted to determine effect from ingestion of the toxicant or the polyacrylamide bait.

Foxes were observed eating the polyacrylamide baits during camera monitoring prior to the 2012 pilot study. No adverse effects were recorded and foxes remained at the bait sites for only a few minutes.

LD50 data for rats indicate that a small fox, or pup, (0.8 kg) would need to eat 144 gallons of bait at 6 ppm thiamethoxam to achieve oral LD50 levels estimated for rats. Consuming this large quantity of bait is not likely to be physically possible and monitoring did not detect very high interest in the baits by any individual island fox.

In 2012 and 2013, forty individual island foxes were trapped in the treatment area in 73 trap nights. None of the individuals presented a hard or distended abdomen. Four animals produced healthy scat samples while being handled. Trapping was conducted pre- and post- treatment in 2013. Fifteen individuals were captured at the Canada del Puerto site in May and twelve of those individuals were captured again in November 2013. Most had gained weight during the course of the treatment months and presented with a healthy body condition. Fox scat containing the polyacrylamide was collected in the treatment zone indicating that a) foxes were eating the bait and b) were successfully passing the bait.

Island Skunk

NPS and TNC have not documented any interaction between the bait and island skunks. Camera monitoring did not indicate any attraction by island skunks to the bait. Islands skunks are primarily carnivorous and are not likely to be attracted to colorless balls of carbohydrates. A small adult skunk weighs about 0.8 kg, thus an average skunk would need to eat 144 gallons of bait at 6 ppm thiamethoxam to achieve oral LD50 levels recorded for rats.

Rare Plants

Although Santa Cruz Island silver lotus and Santa Cruz Island bush mallow are found within the infestation sites, they are not likely to be affected (see section on impacts to vegetation).

Water Quality

Under Alternative B, no changes to freshwater water quality would be expected on Santa Cruz Island. Bait would not be deployed in water or within a 5 m buffer. It is expected that very little of the active ingredient in the bait would leech into the surrounding soil as the vast majority of the active ingredient is contained in the polyacrylamide and does not contact the soil. The low concentration of the toxicant also reduces the amount of toxicant available to leech in the soil. Bait would be applied during the dry season (which coincides with the period of activity of the Argentine ants). NPS and TNC would only apply bait if rain is not predicted in the 7 day forecast.

There is a chance some bait may enter marine waters, as 2 km of the Valley Anchorage treatment area is located next to the shoreline. However due to the low toxicity of the pesticide and the low amount of bait expected to accidentally enter the marine system (as the helicopter uses a GPS and calculated swath width for the hopper application) it is not expected that organisms are likely to be affected. Any

bait entering the marine environment would be incidental and unintended. It is expected that impact to water quality would be minor.

Water Quantity

The proposed project would use approximately 13,000 gallons of groundwater every two to four weeks over a seven month period. Relative to mainland water uses where one average American uses an estimated 80-100 gallons of water each day, (USGS http://water.usgs.gov/edu/qa-home-percapita.html, accessed 8/1/14), i.e. 1,120-1,400 gallons every two weeks, this project's water use (which is 13,000 gallons) is equivalent to 10-12 people living on the island. The western 90% of the island (the central valley aquifer) regularly supports between 10-30 visitors, therefore is currently accommodating water use fluctuations within this range.

Vegetation

Under Alternative B, it is unlikely that vegetation would be negatively affected. Bait deployment via helicopter limits eliminates the need to hike into affected areas to treat those areas, thus eliminating native vegetation trampling. During post-treatment monitoring activities, some damage to vegetation is expected when technicians hike into treated areas.

Improvement to native vegetation is expected when seed production is no longer negatively impacted by the presence of Argentine ants and seed harvester ants are not eliminated from the system (Hanna et al. in press). It is expected that impacts to vegetation would be negligible.

Visitor Use and Experience

Valley Anchorage and the U.C. Reserve are both utilized by visitors and infested with Argentine ants. The Blue Site, on NPS property, is closed to visitation in order to ensure that Argentine ants are not inadvertently moved to another location. If Argentine ants are eliminated from the Blue Site, this area would be opened to visitation. However, visitation has historically been low at this site.

Visitors would be impacted by the presence of a helicopter for 6-8hours each day that bait is deployed, for up to 24 days. Generally there are 1-2 private boats at Valley Anchorage on the weekend, and they may see the treatment occurring. Few private boats are present during the week. For this reason, baiting would take place primarily during the week. It is expected that impacts to visitor use and experience would be negligible.

Effect on Wilderness Eligibility

The "Action" alternative would have no effect on Wilderness eligibility. The project does not involve the installation of any permanent structures.

The project does involve the temporary use of mechanical equipment, primarily a helicopter to distribute bait. Therefore, there is a temporary degradation of solitude on lands where visitors could occur that would be within hearing distance of the helicopter. The project lands are not near the primary public use areas of Santa Cruz Island (Scorpion, Prisoners, and the hiking trails near these locations) and no visual or auditory impact is expected for those visitors. A helicopter for the distribution of bait is the minimum tool on the steep, unroaded terrain on NPS lands.

The Action alternative would improve the natural character of the Wilderness-eligible lands. The project would eliminate the biological impacts of non-native Argentine ants on the island.

Cumulative Effects

There are a number of research project ongoing on this island, including bird counts, ecological monitoring of vegetation communities, rare plants, island fox, and landbirds, island scrub-jay research, photo monitoring for ecological recovery, control of non-native plants, and archeological work. These activities are primarily conducted outside the project sites. The cumulative impact of these researchers and the Argentine ant program is expected to be negligible.

NPS completed an Environmental Impact Statement for the Prisoner's Harbor Coastal Restoration Project in 2012. This project primarily impacts areas outside of the project area, with expected secondary impacts benefiting the watershed inside the project area. There are no cumulative impacts expected.

There are annual projects that seek to eradicate 24 species of nonnative plants, and control projects that target nonnative fennel, eucalyptus, Italian Stone Pines, and European Olives. The eradication effort uses a helicopter. However this work takes place prior to the Argentine ant project start date in May. The control projects are conducted outside the project areas and would be achieved by technicians on foot. There are no cumulative impacts expected.

TNC and NPS are conducting a vegetation and weed mapping effort on SCI. This effort also uses a helicopter. It is anticipated that the project would end before the start of the proposed Argentine ant project; therefore no cumulative effects are expected.

TNC and NPS conduct annual island fox trapping, which is conducted for 6 days in the location of Argentine ant infested areas during the proposed baiting season. It is possible that these two projects would overlap in occurrence. Most likely, the result would be fewer foxes would be trapped during annual trapping as the ant bait may distract them from entering a trap. The cumulative impacts of this project are expected to be negligible.

Summary of Impacts of Alternatives A and B

Table 7. Summary Comparison of Impacts of Alternatives

	No Action	**Alterative 2**
Invertebrates	PS	LS
Terrestrial Mammals	LS	LS
Island fox	LS	LS
Island skunk	LS	LS
T&E Species	LS	LS

Water Quality	LS	LS
Water Quantity	N	N
Effects on Aquatic Resources	LS	LS*
Vegetation	PS	LS
Visitor Use & Experience	N	LS
Cumulative Effects	LS	LS

- Thiamethoxam and other pesticides have the potential to have significant impacts on aquatic invertebrates. This project will apply the toxicant during dry periods, when rain is not in the 7-day forecast, in May- November in order to ensure that runoff into streams is unlikely and the potential impacts to aquatic resources are "Less-than-significant".

Key:
LS = Less-than-significant impact
N = No impact
Na = Not applicable
PS = Potentially significant impact
SM = Potentially significant but mitigable impact
SU = Potentially significant and unavoidable impact

Section 5 – Coordination, Consultation, and Permits

The project has two sponsoring organizations: landowners TNC and the NPS. Each organization is contributing to project planning, field assessment of extent and impacts of Argentine Ants, public outreach, funding, and implementation of the project. The project occurs on lands owned by each organization. Environmental compliance for this project would be in accord with Section 102(2)(c) of the National Environmental Policy Act (NEPA) (42 US Code 4321 et seq.), the California Environmental Quality Act (CEQA) (California Public Resources Code Section 21000 et seq.), state CEQA guidelines (14 California Code of Regulations 15000 et seq.), National Park Service policy, and US Department of Interior policy.

Channel Islands National Park (CINP) has prepared this Environmental Assessment (EA) to identify and assess potential impacts associated with control of Argentine Ants on Santa Cruz Island, CA.

Experimental and small scale field trials to develop methods for Argentine ant control on Santa Cruz Island have been conducted under a letter of Exemption from the Environmental Protection Agency (2012), Categorical Exclusions (Channel Islands National Park; May 4, 2012 and August 18, 2012) and Pesticide Research Authorization (California Department of Pesticide Regulation 1305028).

Federal

The Environmental Protection Agency issued an Experimental Use Permit (EUP) for use of thiamethoxam baits described here to treat Argentine ants on the California Channel Islands (89927-EUP-1).

US Fish and Wildlife Service was informally consulted in March 2013 regarding field trials. Following these discussions, NPS determined that the trials would have "No Effect" on any federally listed species. On August 26, 2014 the NPS discussed the proposed expansion of the project to include treatment of all of the Argentine ant infestation with FWS staff. Data and observations collected during the field trials were discussed. As a result of this discussion, NPS will seek the concurrence from FWS that the expanded Argentine ant Management project "may affect; Is not likely to adversely affect" the Santa Cruz Island fox.

State of California

A research authorization was issued by the Department of Pesticide Regulation (DPR) to the Nature Conservancy following the restrictions outlined in the EUP (RA No. 1305028). DPR was consulted on various occasions, including an office visit on February 7, 2013.

The Department of Fish and Wildlife consulted about the intent to apply pesticides and approval for the project was received via email on May 8, 2013.

County of Santa Barbara

The Country of Santa Barbara was notified of intent to apply restricted materials on Santa Cruz Island in 2012 and 2013.

Scoping

2009 Workshop

Studies of the effects of Argentine ants on the California mainland and other parts of the world have indicated the potential for significant damage to populations of many of the known 33 native ant species on the island, as well as other native insects and even some of the native birds, amphibians and reptiles.

Recognizing this, in fall of 2009 TNC and NPS, hosted 16 Argentine ant biologists and pest control experts to view the infestations and present recommendations for future Argentine ant management. The workshop participants felt that it is still possible and practical to contain or eliminate Argentine ants from Santa Cruz Island with a well-executed management program.

Participants outlined the requirements of an effective control and elimination strategy:

- The bait must be attractive to the ants and in sufficiently small particles that it could be ingested
- The toxin may not be repellent to workers gathering food for the colony
- The toxin must have delayed action in order to allow time for workers to carry the toxin back to the colony and feed to their nest mates (Davis and Van Schagen 1993).
- The toxin must be effective over a large range of concentrations (to counter dilution through food exchange) (Stringer et al. 1964).
- All targeted Argentine ant colonies must be effectively treated.

Additionally, the above requirements must be achieved with no more than minimal and short-term negative effects on native flora and fauna.

The group's consensus findings and recommendations were:

1. If not contained, Argentine ants are likely to cause significant damage to the Island's biological diversity, particularly to native ants and other arthropods.
2. The 2009 surveys used sub-optimal methods and may have failed to detect infestations at some sites. Additional detection work should be carried out.
3. It may still be possible and practical to contain or eliminate Argentine ants from Santa Cruz Island and therefore a management program should be initiated (Randall et al. 2010).

2012 Internal NPS/TNC Scoping

In 2011 and 2012 NPS and TNC completed internal review and scoping for the 2012 and 2013 pilot projects. TNC and NPS concluded that the pilot studies would be conducted to 1) test the efficacy of a newly designed bait and delivery system, and 2) document the effect of the baiting strategy on non-target species. USFWS was consulted regarding impacts to listed species. A Research Authorization was obtained by TNC from the California Department of Pesticide Regulation authorizing the use of two low-concentration baits on Santa Cruz Island (permit no. 1204015 and 1305028). In 2012 the EPA issued a letter a exempting the project from an Experimental Use Permit (EUP) because the small extent of the 2012 project. In 2013 the EPA issued an EUP to treat 1600 acres for Argentine ants on the California Channel Islands (permit no. 89927-EUP-1) and the permit was utilized during the 2013 pilot study.

2012 and 2013 Presentations to Island Fox meetings

At the 2012 and 2013 Island fox Recovery Meetings held in June of these years in Ventura California, TNC updated the Island Fox Recovery Group regarding the Argentine ant project. A thorough discussion of the bait and the LD50 levels in rodents was presented. Initial data on fox use of the bait record via camera traps (2012) and live trapping (2013) was presented.

2013 Experts meeting in Ventura, CA

A second meeting of Argentine ant biologists and pest control experts was convened in February 2013 to review the results of the 2012 pilot study and provide recommendations for a 2013 study. The group concluded that the results of the 2012 pilot study did merit a second pilot study that should be conducted over entire infestations to reduce the confounding effects of re-infestation from outside of treatment boundaries. The group recommended additional treatments (more than the four treatments conducted in 2012) to increase the likelihood of eradication. Also that the use of a hopper and a helicopter would increase the efficacy of the treatment by speeding up the delivery system and increasing the rate of the application may achieve better coverage of infested areas. Since significant changes to the 2012 protocol were being suggested, the group suggested a second pilot study would need to be undertaken to determine the efficacy of a protocol that included the suggested modifications.

2013 Experts Teleconference

In December 2013 a teleconference call was initiated with TNC, NPS and the Argentine ant biologists and pest control experts to review the results of the 2013 pilot and provide suggestions for the program. The group concluded that the monitoring conducted in 2013 showed promising results using the new

methodology. The data warranted further investigation via monitoring and treatment of any spot populations found inside the treatment area. It was recommended that efforts to obtain permits to conduct the eradication protocol piloted in 2013 should begin immediately. It was recognized that if the infestations on SCI are treated sooner, they will be smaller, and less toxicant and fewer logistics will be required to control or eradicate the infestations.

2014 Internal Scoping

August 26, 2014

NPS hosted a meeting with park staff (including the Superintendent and biologists), TNC, and two biologists with U.S. Fish and Wildlife Service to discuss the field trial results and the proposed expansion of the project to treat the entire Argentine ant infestation area. Much of the discussion focused on the interaction between federally endangered Santa Cruz Island fox and the project. Issues of particular concern were a) potential for impacts to reproduction and pup survival by project activities, b) potential impacts from ingestion of bait gel beads, and c) potential impacts for the insecticide in the gel beads.

All participants felt that there is no evidence from field trials or from data regarding the insecticide that the project would adversely affect island foxes. However, because the foxes have been observed to eat the bait, it was felt that the park should determine that the project "may affect; not likely to adversely affect" the island fox and request concurrence from FWS.

Public Scoping

Public scoping began on August 22, 2014 with a press release, a letter to interested public and organizations (61 entities), and establishment of a project web site. The Ventura Star published an article regarding the project and the scoping process on August 28, 2014. Responses of interest in review of the Environmental Assessment were received from three federal agencies (Department of Defense, U.S. Fish and Wildlife Service, and National Oceanic and Atmospheric Administration – Sanctuaries) that have stewardship responsibilities at the Channel Islands.

Distribution of the Environmental Assessment

The availability of the Environmental Assessment will be sent to the current mailing list of interested public and organizations. The Environmental Assessment will be available digitally on the NPS web site. Printed copies of the document will be sent to the following libraries: City of Oxnard, Santa Barbara, Santa Paula, Thousand Oaks, Ventura, and Camarillo.

Applicable Laws and Permits

Coastal Zone Management Act

Federal agency activities in or affecting California's coastal zone must comply with § 307 of the Coastal Zone Management Act and implementing regulations, which require that such federal activities be conducted in a manner consistent to the maximum extent practicable with California's Coastal Management Program.

Although Channel Islands National Park is federal land and excluded from California's coastal zone, the park is geographically within the coastal zone. The Park Service has determined that the preferred

alternative described in this plan is consistent with California's Coastal Management Program. Specifically, the preferred alternative is consistent with chapter 3 of the California Coastal Act of 1976 regarding public access, recreation, the marine environment, land resources, and development.

This plan provides the substantive basis for the NPS's consistency determination and the Park Service will submit this document to the California Coastal Commission for its concurrence. This consistency determination and the commission's concurrence comply with the requirements of the Coastal Zone Management Act.

National Marine Sanctuary Act

This project will require a permit from NOAA Sanctuaries. The marine waters surrounding Santa Cruz Island are within the Channel Islands National Marine Sanctuary. There is the potential that bait applied to the coastal areas of the "Valley Anchorage" infestation of Argentine ants could reach the marine waters. This plan provides the substantive basis for support of the permit that will be requested of NOAA Sanctuaries.

Marine Mammal Protection Act

This project is not expected to cause disturbance of marine mammals protected under the Marine Mammal Protection Act.

Endangered Species Act

The park has informally consulted with the Ventura Fish and Wildlife Service Office regarding the potential for this project to affect federally listed plants or animals on Santa Cruz Island. The USFWS concurred on October 22, 2014 with the park's determination that the only federally listed species that may be affected by the project is the Santa Cruz Island fox. They concluded that any potential effect would be insignificant and therefore, the project is not likely to adversely affect the Santa Cruz Island fox.

Section 6. List of Preparers

Individuals who participated in the preparation of this Environmental Assessment are listed below:

National Park Service

Kate Roney Faulkner, MS in Wildlife and Entomology, Chief of Natural Resources at Channel Island National Park

Paula Power, MS in Plant Ecology, Vegetation Ecologist at Channel Islands National Park.

The Nature Conservancy

Christina Boser, MS in Ecology, California Islands Ecologist

John Randall, PhD in Plant Ecology, Lead Scientist for the South Coasts and Desert Region

California State University

Cause Hanna, PhD in Ecology, Research Station Manager

Section 7. Abbreviations

CEQA	California Environmental Quality Act
CINP	Channel Islands National Park
EA	Environmental Assessment
EPA	Environmental Protection Agency
EUP	Experimental Use Permit
GIS	Geographic Information Systems
IS	Initial Study
LD50	Lethal Dose 50%
MSDS	Material Safety Data Sheet
NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
NPS	National Park Service
PPE	Personal Protective Equipment
PPM	Parts Per Million
PUP	Pesticide Use Proposal
RA	Research Authorization
SCI	Santa Cruz Island
TNC	The Nature Conservancy
UC	University of California

Section 8. References Cited

Banko, P. C., P. T. Oboyski, J. W. Slotterback, S. J. Dougill, D. M. Goltz, L. Johnson, M. E. Laut, and T. C. Murray. 2002. Availability of food resources, distribution of invasive species, and conservation of a Hawaiian bird along a gradient of elevation. Journal of Biogeography 29: 789-808.

Boser, C. 2011. Argentine ant rate of spread in two populations on Santa Cruz Island, CA. Unpublished report prepared for The Nature Conservancy. 8 pp.

Boser, C. L, C. Hanna, K. R. Faulkner, C. Cory, J. M. Randall, and S. A. Morrison. Argentine ant management in conservation areas: Results of a pilot study. *In press* Western North American Naturalist.

Boser, C., Pers comm. The Nature Conservancy; California Islands Project.

Brown, P. E. 1980. Distribution of bats of the California Channel Islands. *In:* The California Islands: Proceedings of a Multi-disciplinary Symposium. Edited by D. M. Power. Pp 751-756. Santa Barbara Natural History Museum, Santa Barbara, California.

Brown, P. E., R. Berry, and C. Brown. 1994. Foraging Behavior of Townsend's Big-eared Bats (*Plecotus townsendii*) on Santa Cruz Island. *In*: Proceedings of the Fourth California Islands Symposium.

Update on tile Status of Resources. Edited by W. L. Halvorson and G. J. Maender. Pp 367-370. Santa Barbara Museum of Natural History, Santa Barbara, California.

Calderwood, J.A., A.M. Wenner, and J. K. Wetterer. 1999. Argentine ants (Hymenoptera: Formicidae) invade California's Santa Cruz Island. *I:n* Proceedings of the Fifth California Islands Symposium. Edited by Browne, D.R., K.L. Mitchell, and H.W. Chaney. Pp 274-277. U.S. Dept. Interior, Mineral Management Service.

Carney, S. E., M. B. Byerley and D. A. Holway. 2003. Invasive Argentine ants (Linepithema humile) do not replace native ants as seed dispersers of Dendromecon rigida (Papaveraceae) in California, USA. Oecologia 135: 576-582.

Chalcraft, D. R., and R. M. Andrews. 1999. Predation on lizard eggs by ants: Species interactions in a variable physical environment. Oecologia 119: 285-292.

Choe, D. H., R. S. Vetter, and M. K. Rust. 2010. Development of virtual bait stations to control Argentine ants (Hymenoptera: Formicidae) in environmentally sensitive habitats. Journal of Economic Entomology 103:1761-1769.

Coastal Restoration Consultants, Inc. 2009. Preliminary survey for Argentine Ants on Santa Cruz Island. Report to The Nature Conservancy. 23 pp.

Cole, F.R., A.C. Medeiros, L.L. Loope, and W.W. Zuehlke. 1992. Effects of the Argentine ant on arthropod fauna of Hawaiian high-elevation shrubland. Ecology 73: 1313-1322.

Collins P.W. 2011. Bird Checklist Channel Islands National Park. 7 pp.

Coonan, T. J., C. A. Schwemm, and D. K. Garcelon. 2010. Decline and recovery of the island fox: a case study for population recovery. Cambridge University Press, Cambridge, United Kingdom. 212 pp.

Crooks, K. 1994. Demography and status of the island fox and the island spotted skunk on Santa Cruz Island, California. Southwestern Naturalist 39: 257–262.

Crooks, K. R. and D. Van Vuren, D. 1995. Resource utilization by two insular endemic mammalian carnivores, the island fox and island spotted skunk. Oecologia 104: 301-307.

Davis, P. R., J. J. van Schagen, M. A. Widmer, and T. J. Craven. 1993. A review of Argentine ant research in western Australia. Agriculture Protection Board of Western Australia Progress Report. 93 pp.

Delaney, K. S. and R. K. Wayne. 2005. Adaptive units for conservation: Population distinction and historic extinctions in the Island Scrub-Jay. Conservation Biology. 19: 523-533.

Elton, C. S. 1958. The ecology of invasions by animals and plants. London: Methuen.

FBA Consulting. 2010. Argentine ant (*Linepithema humile*) delimitation survey on Santa Cruz Island for the Nature Conservancy. Unpublished report prepared for The Nature Conservancy. 81 pp.

Furlong, L. J. 1999. Biogeography and ecology of Santa Cruz Island Streams. Ph.D. Dissertation, University of California, Santa Barbara, CA.

Hanna, C. and C. Boser. 2013. Santa Cruz Island Argentine Ant Pilot Study; Treatment of 180 acres via helicopter, Santa Cruz Island, CA. 28 pp.

Hanna, C., I. Naughton, C. Boser, R. Alarcon, K. Hung, and D. Holway. 2013. Floral visitation by the Argentine ant reduces plant fitness and alters network structure. In press at Ecology.

Hoffmann B. D., and K. L. Abbott, P. Davis. 2010. Invasive ant management. Ant Ecology. (eds L. Lach, C. L. Parr, and K. L. Abbott), pp. 287-304. Oxford University Press, Oxford, UK.

Holway, D. A. 1998. Effect of Argentine ant invasions on ground dwelling arthropods in northern California riparian woodlands. Oecologia 116: 252-258.

Holway, D. A., L. Lach; A. V. Suarez; N. D. Tsutsui; T. J. Case. 2002. The causes and consequences of ant invasions. Annual Review of Ecology and Systematics, 33: 181-233.

Holway, D. A., and C. Hanna. 2011. Ecological effects of argentine ant invasions on Santa Cruz Island, California: Final report of fieldwork conducted in 2011. Report issued to The Nature Conservancy and National Park Service. 10 pp.

Human, K. G., and D. M. Gordon. 1997. Effects of Argentine ants on invertebrate biodiversity in northern California. Conservation Biology 11: 1242-1248.

Krushelnycky, P. D., and R. G. Gillespie. 2008. Compositional and functional stability of arthropod communities in the face of ant invasions. Ecological Applications 18: 1547–1562.

Lach, L. 2008. Floral visitation patterns of two invasive ant species and their effects on other hymenopteran visitors. Ecological Entomology 33: 155-160.

Laughrin, L. L. 1977. The island fox: a field study of its behavior and ecology. Ph.D. dissertation, University of California, Santa Barbara. 83 pp.

Millberg, P., and T. Tyrberg. 1993. Naïve birds and noble savages - a review of man-caused prehistoric extinctions of island birds. Ecography 16: 229-250.

Moore, C. M. and P. W. Collins. 1995. *Urocyon littoralis*. Mammalian Species No. 489: 1-7.

Owens, I. P. F., and P. M. Bennett. 2000. Ecological basis of extinction risk in birds: Habitat loss versus human persecution and introduced predators. Proceedings of the National Academy of Sciences 97: 12144-12148.

Powell, J. A. and C. L Hogue. 1979. California insects. University of California Press, Berkeley, California.

Powell, J. A. 1994. Biogeography of Lepidoptera on the California Channel Islands. Pages 449–464. In: Halvorson, W.L. and G.J. Maender (eds.), The Fourth California Islands Symposium: Update on the Status of Resources. Santa Barbara Museum of Natural History, Santa Barbara, CA.

Randall, J. M., K. R. Faulkner, C. Boser, C. Cory, P. Power, L. A. Vermeer, L. Lozier, and S. A. Morrison. 2011. Argentine ants on Santa Cruz Island, California: conservation issues and management options. *In:* Island invasives: eradication and management. Edited by C. R. Veitch, M. N. Clout, and D. R. Towns. Pp 108-113. IUCN, Gland, Switzerland.

Roemer, G.W. 1999. The ecology and conservation of the island fox (*Urocyon littoralis*). Ph.D. dissertation, University of California, Los Angeles. 229 pp.

Rust, M. 2011. Unpublished report for The Nature Conservancy. 6 pp.

Sharpe, P., Institute for Wildlife Services. Pers Comm.

Sillett, T. S., R. B. Chandler, J. A. Royle, M. Kery, and S. A. Morrison. 2012. Hierarchical distance-sampling models to estimate population size and habitat-specific abundance of an island endemic. Ecological Applications 77: 1997-2006.

Suarez A. V., D. A. Holway, and T. J. Case. 2001. Patterns of spread in biological invasions dominated by long-distance jump dispersal: insights from Argentine ants. Proceedings of the National Academy of Sciences 98: 1095-1100.

Stringer, C. E., Jr., C. S. Lofgren and F. J. Bartlett. 1964. Imported fire ant toxic bait studies: evaluation of toxicants. Journal of Economic Entomology 57:941-945.

Wetterer, J. K., P. S. Ward, A. L. Wetterer, J. T. Longino, J. C. Trager and S. E. Miller. 2000. Ants (Hymenoptera: Formicidae) of Santa Cruz Island, California. Bulletin of the Southern California Academy of Sciences 99: 25-31.

Thompson, C. M., E. L. Stackhouse, G. W. Roemer, and D. K. Garcelon. 1998. Home range and density of the island fox in China Canyon, San Clemente Island, California. U. S. Navy, Natural Resources Management Branch, Southwest Div., Nav. Fac. Eng. Command, San Diego, California. 31 pp.

Von Bloeker, J. C., Jr. 1967. The land mammals of the Southern California Islands. *In:* Proceedings of the symposium on the biology of the California Islands. Editied by R. N. Philbrick. Pp. 245-264. Santa Barbara Botanic Garden, Santa Barbara, California.

Ward, P. S. 1987. Distribution of the introduced Argentine ant (*Iridomyrmex humilis*) in natural habitats of the Lower Sacramento Valley and its effects on the indigenous ant fauna. Hilgardia 55:1.16.

Wenner, A. M. and R. W. Thorp. 1993. The honey bees of Santa Cruz Island. Bee Culture. 121:272-275.

U.S. Fish and Wildlife Service. 2000. Thirteen Plant Taxa from the Northern Channel Islands Recovery Plan.