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An Analysis of materials suitable for use as a pitfall trap in a desert environment

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Introduction

Problem statement

The purpose of this study is to identify a type of pitfall trap container that can withstand the temperature extremes of the Mojave Desert in which the terrestrial, or above ground, drift fence with pitfall traps will be utilized for trapping reptiles. A pitfall trap is a container, such as a plastic bucket with a plastic lid, that is buried in the ground up to the lip of the bucket and used to catch small ground dwelling fauna that fall into the trap. Many different pitfall trap materials have been utilized in the trapping of small ground-dwelling fauna. Plastic has been the most common material used in pitfall trap containers, or buckets, in many different climates around the world. However, plastic is probably a very inefficient material for pitfall trap containers utilized in a desert environment due to extremely dry conditions and extreme temperature fluctuations.

Pitfall trap containers have been used for trapping small ground-dwelling fauna in many regions of the world. Plastic pitfall trap containers have been a common trapping method utilized for trapping small ground-dwelling fauna. Plastic buckets and other containers are used in reptile surveys in order for scientists to survey the health and well being of individual reptiles. Reptiles are examined, weighed and measured.

Definition of Terms

The reptile surveys, conducted by the Las Vegas Wash Project Coordination Team of the Southern Nevada Water Authority, began in April and ended in September for the past two years as described by the Las Vegas Wash Project Coordination Committee (2002). The array sites were located on the north side of the Las Vegas Wash.

The reptile surveys, as conducted by the Las Vegas Wash Project Coordination Team, consisted of six array sites located in various terrains. In each array, ten 5-gallon plastic buckets were used, with ordinary, snap on plastic lids propped up by three wooden legs. Trapping periods lasted for three days. The pitfall traps at the reptile survey sites were opened every other Tuesday afternoon and left open until Friday morning. The plastic pitfall trap buckets were sealed with plastic lids after each season, and left in the ground. The lids were sealed tightly in order to prevent animals from entering and dying.

After one year, the lids and the lips of the plastic pitfall trap buckets broke, cracked, and crumbled to pieces. The ultraviolet light from nearly year-round sunshine in the Mojave Desert caused the lids and lips of the plastic buckets to become extremely fragile, which led to breaking, cracking, and crumbling. Also, another contributing factor, besides the ultraviolet rays from the sunshine, that resulted in cracking and breaking down the plastic buckets were prying open the lids of the buckets at the beginning of each reptile survey and tightly closing them at the end of each reptile survey. This made the traps fatal for small ground-dwelling fauna as soon as the second season or second year of trapping and research began.

It is necessary to replace the plastic pitfall traps with pitfall traps made out of a more durable material because small ground-dwelling fauna have been able to squeeze through the cracks and sometimes fall through holes into the pitfall traps. When this happens, the fauna remains in the traps with no way to escape, and eventually die. There were 10 reptiles and 6 small mammals that died incidentally from falling into these dilapidated, plastic pitfall trap containers during the reptile surveys as noted by the Las Vegas Wash Project Coordination Committee (2002). Accidental deaths associated with the use of plastic pitfall traps utilized in desert climates, has never been addressed because even though plastic becomes fragile and breaks in desert climates, plastic containers remain the cheapest and most readily available type of container for use as pitfall traps.

The temperature extremes along with the ultraviolet light from the sun in a desert climate poses a unique problem regarding pitfall traps compared to cooler and moister climates. In other climates numerous types of traps have been used. The whole idea behind pitfall traps, as stated in Southwood (1978), is that pitfall traps are supposed to have many advantages such as being cheap and should not corrode, break, or melt. NSW Agriculture (1994) goes into more detail about the advantages of pitfall traps, adding to the information provided by Southwood (1978). NSW Agriculture (1994) states that pitfall traps also have the advantages of having no moving parts; they do not kill animals, except inadvertently; they collect a large number of animals; they are safe for the operator; and they are often the only practical alternative for trapping animals.

At the reptile survey sites, the traps at the survey sites have been fatal for some small ground dwelling fauna, especially during the second year. After the first year of the reptile surveys, the 5-gallon plastic pitfall trap buckets resulted in mortality because the lids and the lips of the buckets had become cracked and broken after one year of exposure to the extreme temperatures and searing heat of the Mojave Desert. As a result of their fragility, the plastic pitfall traps and plastic pitfall trap lids were no longer efficient in keeping small ground dwelling fauna out of them during the period of time in between reptile surveys.

Replacing plastic pitfall trap containers, such as the buckets used in the above mentioned reptile surveys, with an alternative type of material is important because the plastic is unable to withstand the temperature extremes of a desert environment. Also, fragile plastic lids that are sealed onto the plastic pitfall trap containers need to be replaced with a more durable type of lid that could last for several years without breaking, cracking, or without being snapped tightly on. If a plastic lid could fit on top of a plastic pitfall trap container without being tightly pressed onto it, the lips of the plastic pitfall trap containers would not be damaged.

The main research question for this study is: is there any alternative type of durable pitfall trap made out of a material that will not need to be replaced as often as ordinary plastic pitfall traps for utilization in a desert climate? If there is not an inexpensive alternative type of durable pitfall trap material, could there be an alternative type of pitfall trap lid that will not need to be snapped tightly onto a pitfall trap container, which would reduce the cracking and breaking of a pitfall trap container as well as reduce the incidental deaths of ground-dwelling fauna? In order to answer these questions, it is necessary to research climate conditions, cost, thermal conductivity, and durability

Background

Pitfall traps have been utilized in North America as well as other parts of the world for trapping arthropods, reptiles, amphibians, and small mammals. There have been many different materials used in many different types of traps. In England, glass jars have been commonly used for trapping beetles. According to Luff (1973), there were three field experiments done regarding capturing beetles near Newcastle upon Tyne, England in between May 12, 1972 and September 20, 1972. These field experiments were performed using and comparing materials such as glass, plastic, and metal. There are a wide variety of materials that are utilized in pitfall traps located in cooler, moister climates. The special climate of a desert requires that a special type of material should be utilized in pitfall trap containers or in lids of pitfall trap containers. Pitfall traps must be used with extreme caution and there must be attention paid to potential sources of variation (Southwood 1978:248), especially when considering the temperature extremes of a desert climate.

A durable pitfall trap container, such as one that could be utilized in a desert climate, must be able to withstand extreme temperatures from about 0 degrees Fahrenheit to 70 degrees Fahrenheit in the winter and from about 65 degrees Fahrenheit to 125 degrees Fahrenheit in the summer.

The criteria for a durable pitfall trap container and/or lid, to be utilized in a desert climate, includes the ability to withstand temperature extremes of a desert climate as well as the ability to withstand wear and tear from the traps being opened and closed. Plastic is not a good material for a pitfall trap container to be made out of unless there is some type of lid that does not have to be tightly snapped on for closure of a pitfall trap. Plastic becomes extremely brittle after being exposed to the desert climate for one year, based on the pitfall traps utilized by the Las Vegas Wash Coordination Team for reptile surveys in the Mojave desert. A better container for a pitfall trap includes material that is not affected by extreme temperature changes and therefore does not become brittle after one year of exposure to temperature extremes. A better pitfall trap container lid would be a lid that would not need to be tightly snapped onto the lip of a pitfall trap container, which causes the lip of the container to break and crumble.

Approach

In order to find out what the alternatives are to plastic pitfall trap containers it is necessary to research information regarding what containers have been used in the past and where these containers were used. It is also necessary to investigate the thermal conductivity of several different materials, or the chemical element that makes up these materials and the cost of different materials.

The Gamma Seal lid, as illustrated in figure 1 on page 12, is the best type of lid for a pitfall trap container because it does not need to be tightly sealed onto the lips of fragile plastic pitfall trap buckets, which have been exposed to the temperature extremes of a desert climate. With this type of lid, an ordinary plastic bucket can be used even if it becomes brittle.

In a desert climate, the use of glass or metal, such as tin, would not be good alternatives to plastic pitfall trap containers. These materials could reach high temperatures, which would cause greater mortality of the fauna that could get trapped in these pitfall trap containers. The high temperatures of a glass or tin pitfall trap container, used in a desert climate, would also be dangerous for researchers to handle because the heating of the traps could result in flesh burns on the hands and forearms. Also, Southwood (1978) explains that since the inside of the pitfall traps must be smooth, metal pitfall traps could corrode and form footholds in which animals that are trapped could use to escape.

Pitfall traps of another type, described by Gist (1973), were used in trapping arthropods in the forests of Macon County, North Carolina. These pitfall traps were made with aluminum soft drink cans with the bottoms cut out and lined with paper cups, which had a hole in the bottom for drainage. The lips of the aluminum cans were placed just below the soil surface. The use of aluminum, as a material for pitfall traps, in a desert environment could be an alternative to the plastic pitfall traps because aluminum can withstand high temperatures and remain cool to touch. Aluminum does trap heat, as well, creating a death trap for small ground-dwelling fauna if the traps are left open after the temperatures in a desert climate reach 100º Fahrenheit.

Although aluminum is not the best choice of material for pitfall traps in a desert climate because of a desert’s temperature extremes, Jones (1986) describes the use of double deep 3 lb. coffee cans as traps for reptiles located in riparian and Chihuahuan Desert habitats. In order to consider aluminum as the best alternative material to plastic pitfall trap containers, it is necessary to understand the amount of heat that is trapped inside an aluminum container in a desert climate during the hottest part of the year. Also, when reptiles are taken out of pitfall trap containers for observing, they are easier to handle if they have been in a cool container because they are cold blooded and are sluggish when they are cold.

The best type of pitfall trap lid, to be utilized in a desert climate, is the Gamma Seal lid. This type of lid is a cheap, but durable alternative to snap on lids. The Gamma Seal lid as illustrated in figure 1, by The Bread Beckers, Inc (2002), is the only easily re-sealing lid that can fit most 12” diameter buckets. The Gamma Seal lid “kit” includes an adapter that slips over the lip of an ordinary plastic bucket and the threaded lid screws into the threaded adapter. Unlike the plastic lids that snap tightly onto a plastic bucket, the Gamma Seal lid easily screws on and off, preventing the lid or the lip of the plastic pitfall trap bucket from cracking or breaking as a result of opening and closing the pitfall trap. The adapter for the Gamma Seal lid also acts as a reinforcement that creates a sturdy pitfall trap container, or bucket, lip.

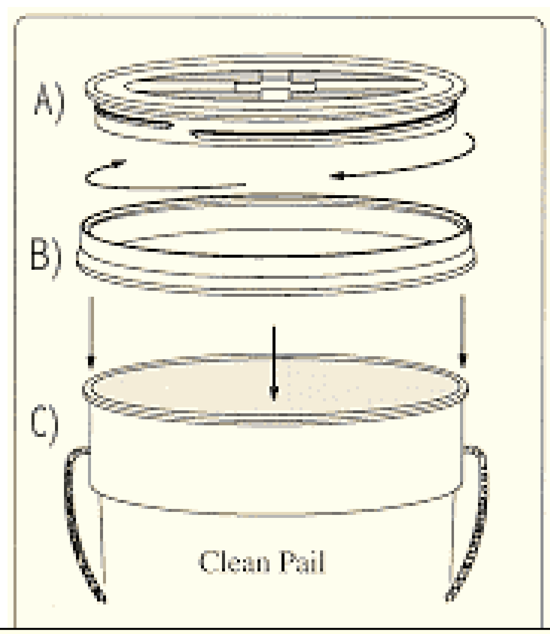

Figure 1: The Gamma Seal lid (A), screws into the adapter (B), which is fitted onto the lip of an ordinary plastic bucket (C). (The Bread Beckers 2002)

Methods

This section consists of the following two sub-sections: Subjects and Design and Procedure and Materials.

<u>Subjects and Design</u>

This thesis was designed in order to decide which type of pitfall trap material is the best material to be utilized in pitfall trap containers located in a desert climate. The criteria for this comparison will be (A) climate conditions, (B) cost, (C) thermal conductivity, (D) durability, and (E) interviews.

<u>Procedure and Materials</u>

I did a comparison of different materials that were considered to be alternatives to the plastic pitfall trap container. All data was collected from book, peer-reviewed journal article sources, and online sources, in order to compare different types of containers and materials used in pitfall trap containers in other climates in the United States of America, England, and Australia.

(A) <u>Climate Conditions</u>

I did research on average high temperatures, average low temperatures and average amounts of precipitation in each location where my literature sources conducted surveys from the beginning of April through the end of May. These months have more hours of sunshine compared to the rest of the year and therefore these months are when the most damage to a pitfall trap container would occur.

(B) Cost

Cost will be compared in a table that demonstrates the average cost of a white, five-gallon plastic bucket, the Gamma Seal lid, a one-gallon glass jar, and a tin paint can. These costs were obtained from online merchant websites and reflect the cost of brand new containers and Gamma Seal lid. The average cost of white, five-gallon buckets was obtained from the listed prices on five online merchant websites. The average cost of the Gamma Seal lid was obtained from the listed prices on ten different online merchant websites. The cost of the one-gallon glass jar was obtained from one merchant website and the cost of the tin paint can was obtained from one merchant website.

(C) Thermal Conductivity

I created a Thermal Conductivity Table in order to understand the thermal conductivity of the chemical elements, such as aluminum, carbon, and tin at 298.2 Kelvin, or 77° F and at 373.2 Kelvin, or 212° F. This was necessary for comparing the change in thermal conductance with the change in temperature because too much thermal conductance in a material made of aluminum, carbon (glass), or tin would not be conducive as a material for pitfall trap containers.

(D) Durability

I compared the issues of durability such as the ability to corrosion. The materials that were compared were plastic, aluminum, glass, and tin. I used my peer-reviewed journal article sources for this comparison.

(E) Interviews

I then proceeded to speak to Seth Shanahan, a former coworker from the Las Vegas Wash Project Coordination Team, and to my senior thesis advisor, Dr. Shawn Gerstenberger, regarding what types of pitfall traps they used in the past for reptile surveys. I also evaluated what type of pitfall trap container material would work best in a desert climate.

Results

In my literature comparisons there were many methods for conducting reptile surveys in various climates; some of these surveys did not even use pitfall traps. The peer-reviewed journal article and book sources either captured ground-dwelling fauna or they used other peer-review journal article and/or book sources to compare techniques for capturing this type of fauna.

Five of my literature sources utilized plastic pitfall trap containers of varying sizes for capturing reptiles, amphibians, and mammals, which is shown in table 1.

As shown in table 1: one of my literature sources utilized aluminum containers for trapping arthropods; one of my literature sources utilized metal, or tin, containers for trapping arthropods; one of my literature sources utilized glass containers for trapping arthropods; and one of my literature sources utilized no container at all.

Table 1:
Peer-reviewed Journal and Book Sources

Type of Container or Lid Used	How Many Used This Type of Container or Lid	Which Type of Ground-dwelling Fauna This Type of Container or Lid Was Used For
Plastic Containers	5	Reptiles, Amphibians, small mammals
White Gamma Seal Lid	0	n/a
Aluminum Container	1	arthropods
Glass Container	1	arthropods
Tin Container	1	arthropods
No Container At All	1	Reptiles, Amphibians

(A) *Climate Conditions*

Crosswhite (1999) utilized five-gallon plastic pitfall containers for capturing reptiles and amphibians located in the Ouachita Mountians in Perry County, Arkansas. Using average temperature data over a thirty-year minimum period of record from The Weather Channel (2003), the average high temperature, April through September, in Perry County, Arkansas is about 86° Fahrenheit; the average low temperature is about 63° Fahrenheit; and the average amount of precipitation is about 4.08 inches. This survey was located in a forest biome consisting of short-leaf pine and upland hardwoods.

Gist (1973) utilized aluminum soft-drink cans for trapping arthropods in Macon County, North Carolina. This trapping occurred in a hardwood forest floor that was located at the Coweeta Hydrologic Laboratory. Using average temperature data over a thirty-year minimum period of record from The Weather Channel (2003), the average high temperature, April through September, in Macon County, North Carolina is about 79° Fahrenheit; the average low temperature is about 54° Fahrenheit; and the average amount of precipitation is about 4.33 inches.

Greenburg (1994) utilized five-gallon plastic pitfall trap containers for trapping reptiles and amphibians in the Ocala National Forest in Marion County, Florida. Greenburg (1994) mentioned that the average temperature, 68-89.6° Fahrenheit, April through October, and 51-73.4° Fahrenheit, November through March, and stated that the amount of rainfall of the climate where the survey took place was approximately 51 inches annually. Using average temperature data over a thirty-year minimum period of record from The Weather Channel (2003), the average high temperature, April through September, in Marion County, Florida is about 88° Fahrenheit; the average low temperature is about 66°

Fahrenheit; and the average amount of precipitation is about 4.99 inches.

Jones (1986) mentioned the utilization of many different types of pitfall traps for capturing reptiles and amphibians, such as five-gallon plastic containers, five-quart tin cans, two-gallon pitfall traps (material not mentioned), searching a predefined area by lifting logs and rocks, and double-deep three-pound coffee cans. The utilization of a five-gallon plastic pitfall trap container was mentioned four times in reference to sources that used these containers in earlier surveys.

The Las Vegas Wash Project Coordination Committee (2002) utilized five-gallon plastic pitfall containers over a period of two years in the Mojave Desert. Using average temperature data over a thirty-year minimum period of record from The Weather Channel (2003), the average high temperature, April through September, in Las Vegas, Nevada is about 94° Fahrenheit; the average low temperature is about 69° Fahrenheit; and the average amount of precipitation is about 0.28 inches.

Luff (1973) utilized small pitfall traps consisting of glass, plastic, and metal. The metal pitfall traps consisted of straight-sided cans of thinsheet tinplate. These pitfall traps were used in capturing arthropods and they were located near Newcastle Upon Tyne, England in a weedy strawberry plot. Using average temperature data over a thirty-year minimum period of record from The Weather Channel (2003), the average high temperature, April through September, in Newcastle Upon Tyne, England is about 59° Fahrenheit; the average low temperature is about 47° Fahrenheit; and the average amount of precipitation was not available.

Milton (1980) discussed a recent study where three methods of surveying reptiles and amphibians, such as the knowledgeable hand collecting, road transects, and walking transects. These surveys were conducted in the Conondale Ranges located in Queensland rain forests and about 75 miles northwest of Brisbane, Australia. This area consists of wet sclerophyll and rain forest.

Southwood (1978) mentions the use of glass, plastic, or metal containers for use as land pitfall traps for capturing arthropods. This source mentions the use of tin as the material in the metal pitfall trap containers.

Williams (1983) used plastic buckets in the mixed conifer and red fir forests of the Western Sierras, located in Nevada, where trapping was conducted in wet and dry meadows as well as riparian deciduous forest areas. This source utilized plastic pitfall trap buckets for capturing mammals. Using average temperature data over a thirty-year minimum period of record from The Weather Channel (2003), the average high temperature, April through September, in the Western Sierras is about 69° Fahrenheit; the average low temperature is about 34° Fahrenheit; and the average amount of precipitation was not available.

(B) Cost Results

The prices of white, five-gallon plastic buckets from five different online companies, such as Harvest House (2003), TAP Plastics (2003), The Home Depot (2003), United States Plastic Corp. (2003), and Yankee Containers (2003) were compared, as shown in table 2. The average cost of white, five-gallon plastic buckets was $4.33.

Table 2:
Average Cost

Type of Container or Lid	Average Cost Each (brand new)
Five Gallon White Plastic Containers/Buckets	$4.33
White Gamma Seal Lid	$8.37
Aluminum can	n/a
One Gallon Glass Jars	$2.95
6.60" Diameter x 12" Tin Paint Can	$2.25

The prices of Gamma Seal lids from ten online companies such as American Family Network (2003), Best Prices Storable Foods (2003), Cody Mercantile (2003, March

1), Cover-Yur-Basics (2003), Harvest House (2003), Qorpak (2003), The Bread Beckers, Inc (2002, November 14), United States Plastic Corp. (2003), Walton Feed (2003), and Wisemen Trading and Supply (2003) were compared. The average cost was $8.37, as shown in table 2. None of my sources utilized the Gamma Seal lid.

The cost of a brand new and unused aluminum can was not available in a general search online. The cost of a one-gallon glass jar was $2.95 each, based on one online vendor, Specialty Bottle (2003). The cost of an average sized large, tin paint can with 6.60” diameter x 12” was $2.25 each, based on one online vendor, Universal Can Company Ltd. (2003). These average costs are illustrated on table 2.

(C) Thermal Conductivity Results

According to Fogiel (1997), the thermal conductivity of the element aluminum (as a solid) ranging from 298.2 to 373.2 Kelvin, or approximately 77° to 212° Fahrenheit, varies only slightly from 2.37 to 2.40 watt/cm/°K. The thermal conductivity of glass, or the element carbon (as a solid and amorphous), from 298.2 to 373.2 Kelvin varies only slightly from 0.0159 to 0.0182 watt/cm/°K. Finally, the thermal conductivity of tin (as a solid and polycrystalline) from 298.2 to 373.2 Kelvin varies only slightly from 0.668 to 0.632 watt/cm/°K. (See Table 3)

Table 3: Thermal Conductivity		
Element	Conductivity (watt/cm/Kelvin) at 298.2 Kelvin	Conductivity (watt/cm/Kelvin) at 373.2 Kelvin
Aluminum (solid)	2.37	2.4
Carbon, or Glass (solid,amorphous)	0.0159	0.0182
Tin (polycrystalline)	0.668	0.632

(D) Durability Results

The durability of plastic containers, aluminum containers, glass containers, and tin containers is summed up in table 4.

Plastic containers are not very durable in any climate with an abundant amount of sunshine year-round. The ultraviolet rays of the sun causes the plastic to crack and break after one year of being exposed (The Las Vegas Wash Coordination Committee 2002). Plastic does not corrode, however.

Aluminum does not corrode. Aluminum is durable when exposed to temperatures above 100° Fahrenheit. Although I did not see data involving aluminum containers and durability, aluminum containers most likely would not break when force is applied to it if it is thick enough.

Glass does not corrode. Glass jars are durable when exposed to temperatures above 100° Fahrenheit. Glass containers break when a certain amount of force is applied to them. The more surface area, or the larger the glass container is, the less force is needed to break a glass container.

Tin corrodes, as mentioned in Southwood (1978). The corrosion of tin lowers the durability of a tin container by making it weak. In a desert climate, the corrosion of tin would probably be slowed down in a desert climate with less precipitation, therefore making a tin container more durable in a drier climate than in a wetter climate.

(E) Interviews

Seth Shanahan, of the Las Vegas Wash Project Coordination Team at the Southern Nevada Water Authority, told me about a new method that will be utilized in future reptile surveys. He told me about how the Las Vegas Wash Project Coordination Team will continue to use plastic pitfall trap buckets; however, they will adopt a new method for closure of the plastic pitfall traps when the reptile surveys are not being conducted. This new method involves the use of Gamma Seal lids, which screw on and off gently. He said that even though the Gamma Seal lids are plastic, they should still withstand the extreme temperatures of the

Mojave Desert because these lids do not have to be pried off when a reptile survey begins. The Gamma Seal lids also do not have to be pressed onto the lips of the pitfall trap buckets when it is time to close the traps, which should make the Gamma Seal lid last longer than a regular plastic bucket lid. Figure 1 shows how the Gamma Seal lid works.

Shawn Gerstenberger of the Environmental Studies Department at UNLV told me that in the past when he conducted reptile surveys, lids were not used at all on the pitfall trap buckets. Instead, limbs of bushes or trees were placed in the pitfall trap buckets during the time that the reptile surveys were not being conducted, allowing animals to climb back out without being harmed.

Discussion

Literature Source Comparisons

Plastic Pitfall Trap Containers

Plastic was the most frequently used material for pitfall traps. The majority of my sources, or peer-reviewed journal articles, has either mentioned or used plastic pitfall trap containers in order to trap fauna, such as reptiles, amphibians and small ground-dwelling mammals.

Three of my sources, such as Greenburg (1994), Crosswhite (1999), and the Las Vegas Wash Project

Coordination Committee (2002), used five-gallon plastic containers for trapping reptiles, amphibians, and small ground-dwelling mammals. According to my sources, reptiles, amphibians, and small ground-dwelling mammals were the most often trapped fauna in five-gallon plastic pitfall trap containers.

None of these sources however took into account the fragility of plastic pitfall trap containers after a certain amount of use and after being exposed to climatological effects over time in any climate. Also, not taken into account by Greenburg (1994), Crosswhite (1999), and Jones (1986) was the fragility of these plastic pitfall trap containers in a desert climate if they were left in the ground with the lids and lips of the containers exposed to the temperature extremes of a desert climate.

The Gamma Seal Lid

Since the Gamma Seal lid is a new idea included in the utilization of pitfall traps, none of my sources have used the Gamma Seal lid with pitfall trap containers during reptile, amphibian, or mammal surveys. Therefore there was no information in my literature source list regarding the use of a Gamma Seal lid in any surveys conducted or mentioned by my sources. However, in my discussion with Seth Shanahan of the Las Vegas Wash Project Coordination

Team, I was told about the future use of Gamma Seal lids on white five-gallon plastic buckets in surveys to be conducted by the Las Vegas Wash Project Coordination Team.

Shawn Gerstenberger mentioned not using a lid at all, but instead place limbs or branches in the pitfall trap buckets in between surveys. However, a lid is needed to keep large fauna from stepping into the unsealed buckets and possibly hurting a leg.

Aluminum, Glass, Metal (Tin), and No Containers

Aluminum, glass, and metal containers were used successfully for arthropod surveys in cooler and more humid climates. However, none of my sources utilized aluminum, glass, or metal containers for capturing reptiles, amphibians, or small ground-dwelling mammals.

Cost

Plastic Pitfall Trap Containers

The average price of a white five-gallon bucket from five different online companies was $4.33. This low price is indicative of how inexpensive five-gallon plastic buckets are. The five different online store sites offered easy payment methods and many choices in different sizes and types of containers, as well as different colors. White was the least expensive bucket color and is most preferable for trapping ground-dwelling fauna because white does not trap heat as much as any of the colors offered at the online store sites. Most agencies that conduct reptile surveys usually do not have the budget for expensive equipment, so plastic has often been used as a material for conducting surveys that include trapping any small ground-dwelling fauna.

Aluminum, Glass, Metal (Tin), and No Containers

My sources used recycled aluminum, glass, and tin containers. This was a good idea because finding merchants that make customized glass containers, such as one-gallon glass jars and customized tin containers, such as paint cans, are not easily found. I could not find a merchant that sells brand new customized aluminum cans.

Recycled aluminum is very cheap and large, used coffee cans could be utilized in place of plastic pitfall trap containers. Jones (1986) mentions the possible use of two large coffee cans taped together for pitfall traps used in capturing reptiles.

Recycled glass jars that are one-gallon in size, which is a good size for catching small reptiles, would be an inexpensive type of container to use in place of plastic pitfall trap containers. For $11.80 per case of four brand-new one-gallon glass jars, glass jars are less expensive per gallon than the average cost of white five-gallon plastic buckets. However, there is five times as much space in a five-gallon bucket. Glass jars are very common storage containers and they could either be purchased new or can be utilized after the store-bought food item is removed.

Recycled tin paint cans would be another inexpensive alternative to plastic pitfall trap containers. Collecting tin paint cans from painting-related businesses may be a good alternative to buying them new

Thermal Conductance

According to Fogiel (1999), aluminum has a thermal conductance of 2.37 watt/cm/Kelvin at 298.2 Kelvin, or around 77° Fahrenheit, and then rises to 2.4 watt/cm/Kelvin at 373.2 Kelvin, or around 212° Fahrenheit. If a material has a thermal conductance above zero, as aluminum does, then it is not a good material for use as a pitfall trap container in a hot desert climate. A thermal conductance greater than zero would trap too much heat during the warmest days of a desert climate, in which the temperature exceeds 100° Fahrenheit. This means that the thermal conductance of aluminum, during the warmest days of a desert climate, would equal an amount in between 2.37 watt/cm/Kelvin and 2.4 watt/cm/Kelvin. If the temperature of a desert climate were in between 100° Fahrenheit, or about 310 Kelvin, and 125° Fahrenheit, or about 324.8 Kelvin, then the thermal conductance of aluminum would be around 2.38 watt/cm/Kelvin. Therefore aluminum would not be a good material to use as pitfall trap material because of its high thermal conductance.

The thermal conductance of the element carbon, the element that glass is created from, according to Fogiel (1999), is 0.0159 watt/cm/Kelvin at 298.2 Kelvin, or about 77° Fahrenheit, and 0.0182 watt/cm/Kelvin at 373.2 Kelvin, or about 212° Fahrenheit. In between 100° Fahrenheit, or about 310 Kelvin, and 125° Fahrenheit, or about 324.8 Kelvin, the conductance of glass remains very low at around 0.0165 watt/cm/Kelvin to around 0.0170 watt/cm/Kelvin. This lower thermal conductance of glass compared to the high thermal conductance of aluminum makes glass a better alternative material when compared to the plastic pitfall trap material.

The thermal conductance of tin, according to Fogiel (1999), is 0.668 watt/cm/Kelvin at 298.2 Kelvin, or about 77° Fahrenheit, and 0.632 watt/cm/Kelvin at 373.2 Kelvin, or about 212° Fahrenheit. Therefore, the thermal conductance remains low and does not change much with an increase in temperature. The thermal conductance of tin would be around 0.064 watt/cm/Kelvin when temperatures in a desert climate would be in between 100° Fahrenheit, or about 310 Kelvin, and 125° Fahrenheit, or about 324.8 Kelvin. The low thermal conductance of tin is lower than the thermal conductance of aluminum and higher than the thermal conductance of glass. Therefore, tin would not trap heat as much as aluminum, but tin would trap more heat than glass. With a low thermal conductance, it is a good alternative material to the plastic pitfall trap container.

Durability

Plastic Pitfall Trap Containers

The use of plastic containers in the desert climate leads to higher replacement rates. Plastic buckets need to be replaced once each year before a reptile survey begins. This would not be a problem if there were perhaps five to ten pitfall traps to replace. However, by using the reptile surveys as conducted by the Las Vegas Wash Project Coordination Team as a model representative of reptile survey sites, there would be sixty buckets to replace each year. Digging up sixty buckets might not be a problem in the softer soil of cooler, moister climates, however digging up sixty fragile plastic buckets in a desert climate, with cement-like soil is very difficult.

Aluminum, Glass, Metal (Tin), and No Containers

Jones (1986) mentions the possible use of aluminum as a material for pitfall trap containers and Gist (1973) utilized aluminum soft drink cans in capturing arthropods in a humid hardwood forest biome. The location of where Gist (1973) conducted his survey, Macon County, North Carolina, has an average high temperature of about 79 Fahrenheit and an average rainfall amount of 4.33 inches in between the beginning of April and the end of September. The durability of aluminum containers is very high no matter where these containers are used, however, the cooler summer temperatures and high precipitation amounts keep aluminum from heating up as much as it would heat up in a desert environment.

Southwood (1978) mentioned glass containers used in the trapping of Arthropods, however none of my sources used glass containers for trapping reptiles. Glass, like plastic, has a tendency to break after a certain amount of use or when enough force is placed on it. Broken glass is much worse than plastic for use over a several year period, because shards of broken glass can lie around in the desert and wound people as well as any fauna that might approach it. Therefore even though small glass containers were used successfully in the arthropod surveys conducted by Luff (1973) in England, a glass container for capturing reptiles would not be conducive in a desert climate if it is to be used over several years. A glass container would be sturdier than a plastic container, but the breakage from a glass container is much more dangerous than breakage from a plastic container. Furthermore, a glass container larger than 32 ounces, which would be the smallest sized conducive for capturing small reptiles, would be cumbersome and heavy, which would make the task of replacing this type of container more difficult than replacing a lightweight plastic container.

Only one of my sources, Southwood (1978), mentioned the use of small metal, or tin, containers for trapping arthropods and one of my sources, Luff (1973), utilized metal, or tin, containers for trapping arthropods. Metal, or tin, eventually corrodes when exposed to climatalogical events in any climate; therefore, the corrosion of metal, or tin, would create footholds in which captured ground-dwelling fauna could escape. Containers with smooth sides are preferable containers for use as pitfall traps. Plastic, glass, and aluminum would be smoother materials for utilization as pitfall trap container materials, compared to corroded tin.

Tin, however, is a stronger material when compared to plastic and could be used over a long period of time, in a desert climate, because of the small amount of precipitation. The higher amount of precipitation in England, where Luff (1973) captured arthropods, would have corroded the tin pitfall traps in a short amount of time if the traps were left in the ground for more than a year. The small amount of precipitation in a desert climate would retard the corrosive effects on tin pitfall trap containers. Tin would be a good alternative material for use in place of plastic pitfall trap containers.

The use of no containers at all in reptile surveys conducted in a desert climate would not be a good alternative to plastic pitfall trap containers. Milton (2002) discussed a survey that was conducted using no container at all. In this survey, conducted in the Conondale Ranges of Australia, the methods used instead of a container include: knowledgeable hand collecting, which includes rummaging through leaf litter and turning over logs; road transects, which involves traveling in vehicles at set distances at predetermined speed along roads; and walking transects, which involves walking a defined distance at a predetermined rate. However, even though Milton (1980) conducted successful surveys through walking transects and road transects, Jones (1986) mentioned that the knowledgeable hand collecting and the walking transects are both destructive for habitats because they involve physically moving groundcover. This type of method is therefore not a good alternative to plastic pitfall trap containers utilized in a desert environment because of destruction to the delicate desert ecosystem that is easily disrupted and has a long-term recovery rate. In a climate with abundant rainfall, the recovery rate would be measured in months, however, in a dry desert climate, recovery rate would be measured in years.

Conclusion

Five-gallon plastic buckets are the cheapest priced containers and most readily available type of pitfall trap because for $4.33, a large container can be bought compared to a small one-gallon glass jar that would cost $2.95. An average size tin paint can is $2.25, which is a big price for a small container when compared to the price of a five-gallon plastic bucket.

Plastic bucket lids and plastic pitfall trap bucket lips do become fragile when exposed to the extreme temperatures of a desert climate, but they are inexpensive to replace and easy to find. Many home improvement stores carry five-gallon plastic buckets in bulk. The Gamma Seal lid can be used instead of an ordinary snap on lid, which would prolong the amount of time that a plastic bucket could be used as a pitfall trap in a desert climate without the lips of it becoming cracked and broken. The Gamma Seal lid would be the best solution to tight-fitting plastic lids that have to be pressed onto the lips of plastic buckets that have been exposed to too much ultraviolet radiation from the mostly sunny days and hot temperatures. The sunniest months in any climate, beginning in April and ending in September, are the months with the longest days compared to the rest of the year. These months are therefore the most damaging months in regards to destruction of plastic pitfall containers due to ultraviolet radiation.

Although there has not been enough studies done regarding what happens to pitfall traps made of aluminum, glass, or tin in a desert environment, government agencies are not going to set aside monies for investigating whether aluminum, glass, or tin would be better materials to use as pitfall trap materials in place of plastic. Reptile surveys will continue to include plastic buckets as many of them already have. Plastic buckets are good to use as pitfall containers in cooler, warmer climates; however, they are not durable in a hot, dry desert climate. When these plastic buckets break, there is a loss in small, ground-dwelling fauna populations. It is not a large loss, but sometimes a rare target species dies as a result of plastic bucket lids and lips being cracked and broken. Using a material that would not break as easily as plastic could avert this loss.

There should be studies done over a two- or three-year period of time involving reptile surveys in a desert climate, while utilizing aluminum, glass, and tin, as well as plastic pitfall trap containers. From those studies, there would be important information about how these containers react in a desert climate and how reptiles react when trapped in each type of pitfall trap container. This could benefit long-term studies where having the most durable container for use in a desert climate would save agencies money in replacement costs.

Agencies could use recycled aluminum, glass, or tin containers instead of buying plastic containers. However, in a desert climate, such as the Mojave Desert, there is the thermal conductance issue with containers made of aluminum and the durability issue regarding containers made of glass. The durability of glass containers is more of an issue if the surveys are too last for more than one year. Tin could be used in a survey conducted in a desert climate over a two- or three-year period of time. Used tin paint buckets could become useful pitfall trap buckets. Tin does not have a very high thermal conductance and containers made of tin could last a very long time in a desert climate, depending on the rainfall amount during the time that the tin containers are suppose to remain in the ground. However, the largest tin paint can, which is 6.60” in diameter by 12” tall is not feasible for capturing anything except small lizards.

References: APA Style

American Family Network. (2003). The Gamma Seal Lid. [Online]. Available: http://www.americanfamilynetwork.com/.

Best Prices Storable Foods. (2003). Gamma Seal Lids. [Online]. Available: http://www.internet-grocer.com/.

Cody Mercantile.(2003, March 1). Gamma Seal Lid. [Online]. Available: http://wwww.codymercantile.com.

Cover-Yur-Basics.(2003). Gamma Seal Lids. [Online]. Available: http://www.cover-yur-basics.com.

Crosswhite, D.L., Fox, S.F., & Thill, R.E. (1999). Comparison of Methods for Monitoring Reptiles and Amphibians in Upland Forests of the Ouachita Mountains. *Proceedings of the Oklahoma Academy of Science 79*, 45-50.

Fogiel, M. [Director] (1997). *Handbook of Mathematical, Scientific, and Engineering Formulas, Tables, Functions, Graphs, Transforms.* New Jersey: Research & Education Association.

Gist, C.S. & Crossly, D.A. (1973). A method for quantifying pitfall trapping. *Environmental Entomology, 2,* 951-2.

Greenburg C.H., Neary, D.G., & Harris, L.D. (1994) A comparison of herpetofaunal sampling effectiveness of pitfall, single-ended, and double-ended funnel traps used with drift fences. *Herpetology, 28,* 319-324.

Harvest House. (2003). Buckets and Supplies. [Online}. Available: http://www.hrvst.com/index_1.html.

Interview: Dr. Shawn Gerstenberger, Greenspun College of Urban Affairs: Environmental Studies Department at the University of Nevada, Las Vegas.

Interview: Seth Shanahan, Southern Nevada Water Authority: The Las Vegas Wash Project Coordination Team.

Jones, K.B. (1986). Amphibians and reptiles. In: Cooperrider, A.Y., Raymond, J.B., & Hanson, R.S., editors. Inventory and monitoring of wildlife habitat. *U.S. Denver: Department of the Interior, Bureau of Land Management Service Center,* p. 267-290.

Las Vegas Wash Coordination Committee. (2002, August). Project Update: Environmental Monitoring, Reptile Survey. [Online]. Available: http://www.lvwash.org/projectupdate/reptilesurvey.html.

Luff, M.L. (1973). Some features influencing the efficiency of pitfall traps. *Oecologia 19,* 345-57.

Milton, K.A. (1980). A comparison of three techniques used in a reptile survey of the Conondale Ranges. *Victorian Naturalist, 97*, 26-31.

NSW Agriculture. (1994, December). Guideline 6 – Guidelines for the use of pitfall traps, 2nd ed. [Online]. Available: http://www.agric.nsw.gov.au/reader/2569.

Qorpak. (2003). Gamma Seal Lids. [Online]. Available: http://www.qorpak.com/.

Southwood, T.R.E., & Henderson, P.A. (1978). *Ecological methods*. London: Chapman and Hall.

Specialty Bottle. (2003). Jugs/Gallon Jars. [Online]. Available: http://www.specialtybottle.com/big.html.

TAP Plastics. (2003). Plastic Buckets/Pails. [Online]. Available: http://www.tapplastics.com/.

The Bread Beckers, Inc. (2002, November 14). Gamma Seal Lids. [Online]. Available: http://www.breadbeckers.com/gammalids.htm.

The Home Depot. (2003). Plastic Buckets and Lids. [Online]. Available: http://www.homedepot.com/.

The Weather Channel. (2003). Monthly Climatology for Travel Section [Online]. Available: http://www.weather.com/weather/climatology/monthly/.

United States Plastic Corp. (2003). 5 gallon buckets. [Online}. Available: http://www.usplastic.com/.

Universal Can Company Ltd. (2003). Products: Paint Cans. [Online]. Available: http://www.universalcan.ca/.

Walton Feed.(2003). Gamma Seal Lids. [Online]. Available: http://waltonfeed.com/gamaseal.html.

Williams, D.F. & Braun, S.E. (1983) Comparison of Pitfall and Conventional Traps for Sampling Small Mammal Populations. *Journal of Wildlife Management, 47*, 841-845.

Wisemen Trading and Supply. (2003). The Gamma Seal Lid. [Online}. Available: http://www.usplastic.com/.

Yankee Containers. (2003). 5 gallon open head white heavy duty high density polyethylene plastic pails. [Online}. Available: http://www.yankeecontainers.com/.