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Plate Waste Trends of 5th-8th Grade Students at a Residential Environmental Learning Center

by

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A capstone submitted in partial fulfillment of the

requirements for the degree of Master of Arts in Education.

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INTRODUCTION

Statement of Problem

George Bernard Shaw said, "There is no sincerer love than the love of food." This is especially true for children and teens that, as parents well know, often consume a lot of food. One would think than that those adolescents would be reluctant to waste food. Unfortunately, both juveniles and adults are wasting an alarming amount of food. In 2012, the Environmental Protection Agency (EPA) found that Americans threw away about 251 million tons of Municipal Solid Waste. Of that trash, 14.5 % (36 million tons) was composed of food waste; the second largest group of waste material analyzed by the EPA.

A similar trend can be seen in schools. On an average school day in 2015, the National School Lunch Program (NSLP) served approximately 30.5 million students with an annual cost to the United States Department of Agriculture (USDA) of $12.9 billion (USDA, 2015). The best national estimate available indicates that about 12% of the calories served in the NSLP are uneaten and subsequently thrown away, resulting in an estimated economic loss of over $600 million (Dwyer, 1995, Buzby& Guthrie, 2002). This estimate is from a large, nationally representative study conducted in 1991-1992 and thus may not reflect current conditions in schools which, in 2015, served free or reduced meals daily to more than 30.5 million students through the NSLP (USDA, 2015).

The massive scale and success of the NSLP program has prompted continual interest in how well this and other food service programs operate. One method for determining the efficiency of a food program is to measure plate waste, which is the proportion of food served

that is uneaten, the amount of calories uneaten, or the amount of nutrients uneaten (Guthrie &

Buzby, 2002). Plate waste not only has financial and environmental impacts, but also may have

implications in terms of the nutritional quality of the school meal program. Balanced, nutritional

meals eaten during childhood can provide a solid foundation in terms of children's health,

well-being, and academic achievement (Centers for Disease Control and Prevention, 2013).

Additionally, good eating habits learned in early life may carry over into adulthood (Duyff,

2002). While completely eliminating plate waste is an unrealistic goal, reducing plate waste

lowers user costs, makes program operations more efficient, and enhances a program's success

in meeting nutritional needs of children (Guthrie & Buzby, 2002). Plate waste is inevitable and it

is unrealistic to completely eliminate however, reducing plate can make program operations

more efficient, lower costs, and keep plate waste out of landfills.

Research Objectives

   The purpose of this study is to determine and analyze trends of plate waste from 81

schools participating in programming over the course of 5 years at Eagle Bluff Environmental

Learning Center. Specifically:

1. To examine the relationship between plate waste and school group size.

2. To examine plate waste trends by school location (rural, urban cluster, and urban).

3. To examine plate waste between grades (5th, 6th, 7th, 8th).

4. To examine plate waste trends by school type (private schools vs. public schools).

5. To examine the relationship between plate waste and time.

Hypothesis

It was hypothesized that there would be no difference in plate waste between grades, school type, or school location. It was also hypothesized that there would be no relationship between plate waste and school group size or plate waste and time.

Definition of Terms

1. <u>Residential Environmental Learning Center</u>- A professionally staffed, full-time, year-round facility which offers hands-on, outdoor-based environmental education to groups over several days.

2. <u>Plate Waste</u> – The amount of food served that is uneaten. The term plate waste has been used in many other studies and has traditionally been assessed via three methods: (1) physical measurements (such as weighing discarded food) (2) visual estimates made by trained observers, and (3) food consumption as recalled by children (Guthrie & Buzby, 2002).

3. <u>Trend Study</u>: A study which uses the same population across time but use different samples from that population each time.

4. <u>Offer vs. Serve</u>: Giving users a choice food options rather than making it mandatory for all food options to be taken. This strategy is used by Eagle Bluff and federally subsidized school lunch and breakfast programs.

CHAPTER 2

A REVIEW OF LITERATURE

Agricultural production (getting food from farms to our plate) accounts for:

- 80 percent of consumptive water use (USDA, 2006)

- 50 percent of U.S. land (USDA, 2002)

- 10 percent of the total U.S. energy budget (Webber, 2012)

Yet, 40% of food in the U.S. goes uneaten (Hall et al., 2009) which amounts to over 20 pounds of food per person each month that is wasted (Buzby & Hyman, 2012). That equates to throwing out the equivalent of 165 billion dollars each year. Given the massive resource demand involved in food production, it is important that the food on our plates goes to good use.

This review will address three areas in regards to plate waste:

1. Factors that influence food choices (i.e. household, media, and school)

2. Background on school food services

3. Plate waste findings -where the major efficiency loses are in the U.S. Food System with regards to plate waste at the consumer level and the implications plate waste has on energy consumption.

Factors that Influence Food Choices

School-age children recognize parents/caregivers, media influences, and teachers and schools as their main influencers in making food decisions (Duyff, 2002).

Caregiver Influences

Children learn about food through the direct experience of eating and by observing the eating behavior of others (Birch et al. 2007). Studies have also shown that children's preferences to food are largely a reflection of the foods that become familiar to them. Caregivers, with out without knowing it, influence the food preferences of their young children and establish the habits and routine for where food is eaten, how it is eaten, with whom its eaten, and how much is eaten (Worthington-Roberts & Williams, 2002).

As children grow older, they have more control and responsibility for what they eat, when they eat, and where they eat. They gradually become more independent of their caregiver and the get better at self-control and understanding other people's points of view (Satter, 1987). This is a time when friends become very important as they are learning how to behave and fit in with their peers and it is this larger community that has a significant influence on food choices.

Media Influences

A national survey by the Kaiser Family Foundation found that 8-18 year-olds spend an average of 7 hours and 38 minutes to using entertainment media on a typical day (Rideout et al., 2010). That is more than 53 hours a week! And, as children become independent, more of their food choices are influenced by media. They are constantly receiving messages about what to eat via the internet, television, print, and/or radio. The multi-million dollar marketing campaigns often target children because they influences purchases made by caregivers in the grocery stores and foods eaten outside of the home. Children are conscious of brands and will demand that specific brands be purchased at the store (Meyer et al., 2002). Food consumed at home and those

packed in school lunches are greatly influenced by food preferences of the child. And with

children being more "plugged-in" than ever, the food companies understand that children have a

large share in the market.

Television in particular has a very profound impact on children's food choices. A 1995

television advertising study evaluated food frequently advertised during peak viewing hours by

children. Of the 21.1 commercials being aired per hour, food advertisements accounted for over

half of all commercials (Taras & Gage, 1995). Of these food advertisements, 90% were foods

that were high in fat, sugar, and salt, The most frequently advertised foods were processed foods

including canned and other prepared foods, and dairy products. Taras and Gage concluded that

unhealthy foods are advertised on television and they suggested that nutrition efforts and

intervention can play an important roles in combating the negative effects of the media's

advertising.

Food Industry influences in School

Schools play an important role in establishing policies and practices to promote a safe

environment that support healthy behaviors. They also provide opportunities for children to learn

and practice healthy eating and physical activity behaviors (Centers for Disease Control and

Prevention, 2013). But, while nutrition education is beneficial and important, research suggests

the most efficient and effective way to improve children's nutrition is to change their food

environment (Schwartz, 2007). Children know which foods are the most healthy, but despite

knowing this, are more likely to choose foods based on convenience and taste (Schwartz, 2007).

This makes school meals an important avenue for teaching/improving healthy eating habits. As

such, the Centers for Disease Control and Prevention have guidelines (2002) set through the School Health Program that recommends schools provide: healthful foods in cafeterias and vending machines; "discourages sale of foods high in fat, sodium, and added sugars on school grounds and as part of fundraising activities"; and "discourages teachers from using food for discipline or rewarding students."

Unfortunately, these guidelines are not followed. Results from the 2001 School Health Policies and Programs Study found that there is a growth of outside influences of school food preparation. The study assessed school food service using questionnaires and interviews at the state and district level in all 50 states. Among the 2,342 schools that participated in the study (a 70% response rate), nearly 50% of districts had a contract for soft drinks, and 79% of these schools received a percentage of sales. Additionally, nearly 35% of these districts allowed the soft drink company to advertise in the school (Wechsler et al., 2001). Vending machines were available in 26% of elementary schools, 60% of junior high schools, and 95% of high schools. Among these schools, students could purchase from vending machines at any time of day in 29% of elementary schools, 39% of junior high schools, and 61% of high schools.

But as the numbers show, not all schools have contracts with soft drink companies or vending machine service. Some school districts have refused to enter deals with them after protests by parents, students, and school staff. In August of 2002, the Los Angeles school district board voted to remove soft drinks off their cafeteria menus and end the sale of soft drinks in vending machines by 2004. This was one of the first large scale bans which affected 677 schools and 736,000 students. Since then, many school districts across the country have followed suit and voted for a similar ban and by the 2010-2011 school year, 47% of high school students were

in a district that banned soda in vending machines (Taber et al., 2015). Overall, the proportion of high school students in the United States who could purchase soda in school was cut in half in a five year span, from 53% in 2006-2007 to 25% in 2010-2011 (Terry-McElrath et al., 2012).

The food industry gains access to schools by marketing its programs and products to school food service personnel, school administrators, teachers, and other professionals who are promised funds and materials for their schools, which are often under-funded (Levine, 2000). In 2009, companies spent $150 million on marketing foods and beverages for elementary, middle, and high schools (Federal Trade Commission, 2012). Companies will even go as far as coming up with nutritional education programs to promote their products. For example, Kellogg developed nutritional education kits to promote Pop Tarts in and General Mills created a program called "Box Tops for Education" that encourages the sale of their products by donating money based on the number of product box tops that students collect.

In addition to these marketing efforts, foods from branded fast food establishments are being offered in school cafeterias. Schools participate by paying royalty fees but not licensing fees. As of 2012, the top national food brand found in schools was Dominos with 34% of schools with restaurant-branded foods serving its products. The other top franchises included Pizza Hut (19%), Papa John's (15%), Subway (12%), and Little Caesars (6%) (Oches, 2012). But, in order to participate in fast food distribution, schools must drop out of the NSLP, which is the most widely used and influential programs for child nutrition in the United States.

School Food Service

Nutritional programs are administered at the federal level by the Food and Nutrition Service

(FNS), the United States Department of Agriculture, and under direction of the Food, Nutrition and Consumer Services. The state agency administering the programs varies from state to state. At a local level, the district board of education administers the specific school programs. Ultimately, the success of these programs depends on the collaboration and cooperation among these different levels (Martin & Conklin, 1999).

Child Nutritional Programs: History

For over 100 years there has been federal programs overseeing nutritional programs in schools thanks to the financial support for local school districts, philanthropic organizations, and private donations (Boyle, 2003). Federal involvement in school food programs increased during the 1930s with a passing of an amendment to the Agricultural Act of 1933 which established a fund to purchase surplus farm commodities for donation to needy families and child nutrition programs (including school lunch programs) (Boyle, 2003). But, during World War II, the surplus of food that had been going to schools was instead diverted to support the U.S. Armed Forces and Allied armies (Martin & Conklin, 1999) . In response, Congress passed the National School Lunch Act (NSLA) in 1946 to ensure nutritious meals would be available to all children, regardless of financial situation via NSLP. This act permanently partnered the federal government with state and local school districts and set a foundation for the development of a strong national child nutrition policy.

In 1966, the Child Nutrition Act (CNA) was passed with the purpose of expanding federal support to child nutrition programs by establishing year-round food assistance programs to children of all ages (Boyle, 2003). The School Breakfast Program and the supplemental food

program for Women, Infants and Children are two programs that came out of this act. The School Breakfast Program was created and is administered the same way the NSLP is and in 2015, 14 million children participated in the breakfast program (USDA, 2016). The successes of these programs lead to further school nutrition initiatives including The Summer Food Service Program, the after-school snack program, and the special milk program for children. These programs are available through formula grants, which distribute funds to states on the basis of a "formula" that takes into account the number of breakfasts or lunches to be served and the national average payment for the program.

NSLP

Developed in 1946 in response to poverty, it is by far the largest food assistance program available to schools. In 2015, nearly 100,000 schools/institutions served school lunches to 30.5 million students each day, including:

- 19.8 million free lunches

- 2.2 million reduced price (student pays $.40)

- 8.5 million full price

- 5 billion lunches are served annually (USDA, 2015)

There are five major requirements for schools to participate in the NSLP: 1. the program operates on a non-profit base; 2. the program must be accountable; 3. schools must make use of the commodity program; 4. children unable to pay the full price of the lunch are to be served at a free or reduced price; 5. lunches are to be based on current nutritional standards. To meet requirement 4, Congress requires the USDA to establish income guidelines annually for schools

to use in determined eligibility for free and reduced-price meals.

There are additional guidelines for children who are eligible for free or reduced-price meals. These guidelines are used by schools, institutions, and facilities participating in the National School Lunch Program (and Commodity School Program), School Breakfast Program, Special Milk Program for Children, Child and Adult Care Food Program and Summer Food Service Program. Children from families with incomes at or below 130 percent of the poverty level are eligible for free meals. Those households with incomes between 130 percent and 185 percent of the poverty level are eligible for reduced‑price meals, for which students can be charged no more than 40 cents (USDA, 2013).

As stated in NSLP requirement number 5, school lunches must meet the applicable recommendations of the Dietary Guidelines for Americans. The current meal pattern increases the availability of fruits, vegetables, and whole grains in the school men and the dietary specifications set specific calorie limits to ensure age-appropriate meals for grades K-5, 6-8, and 9-12. Other meal goals include gradual reductions in the sodium content of the meals. While school lunches must meet Federal meal requirements, decisions about what specific foods to serve and how they are prepared are made by local school food authorities (USDA, 2013).

One of the most recent changes to the NSLP and School Breakfast Program operating standards includes Offer versus Serve (OVS) philosophy. It is a provision that allows students to decline some of the food offered to them. The goals of OVS are to reduce food waste in the school meals programs while permitting students to decline foods they do not intend to eat. This provision is mandatory in high schools but has also become the most common style of meal service in middle and elementary schools.

Plate Waste Findings

Plate waste studies collect data related to fiscal, ecological, and nutritional concerns.

Methodology

There are many different techniques that can be utilized to measure plate waste but they can be divided into two broad categories- direct measures and indirect measures. Direct measure includes weighing the waste of separate food items for individual students or groups of students, weighing the total unseparated waste, and separating and weighing waste from garbage containers. Indirect measurement include measuring food preferences or acceptability, visually estimating the amount of each food items wasted, and asking students to report on the amounts they wasted.

Losses in Food Service

Plate waste is a significant contributor to losses in food service, which result mainly from large portions and undesired accompaniments. On average, diners leave 17 percent of meals uneaten and 55 percent of these potential leftovers are not taken home (Bloom, 2011). Undoubtedly, the increase in portion sizes over the last 30 years is contributing to plate waste. Today some portion sizes are two to eight times larger than the FDA or USDA standard serving sizes (Young & Nestle, 2003). Other drivers for plate waste in the food service industry include (1) expansive menu options, (2) unexpected sales fluctuations, (3) rigid management and, (4) fast-food time limits (Gunders, 2012).

Losses in Households. American families throw out roughly 25% of the food and beverages they buy which, for a family of four, amounts to an estimated 1,365 to 2,275 dollars wasted (Bloom, 2011). Research as to why this loss is so high is lacking in the United States, but anecdotal evidence suggests that losses include: (1) lack of awareness and undervaluing of foods, (2) confusion over label dates, (3) spoilage, (4) impulse and bulk purchases, (5) poor planning, and (6) over-preparation (Gunders, 2012).

Losses at School

A large, nationally representative study conducted in 1991-1992 analyzed the plate waste in school nutrition programs, particularly the NSLP which is overseen by the U.S. Department of Agriculture. In 2000, this program served approximately 27 million students on a typical school day (Buzby & Guthrie, 2002). The best national estimate available indicates that about 12% of the calories served in this program are uneaten. The following are other plate waste findings in schools:

- Girls tend to waste more food than boys (Bark, 1998; Devaney et al., 1995; Reger et al., 1996; USGAO, May 1996).

- Younger children tend to waste more food than older children (USGAO, May 1996, Dillon & Lane, 1989).

- Plate waste varies by food type, with salad, vegetables, and fruit generally reported to be the most wasted items (Bark, 1998; Reger et al., 1996; USGAO, July 1996; USDA/FNS, 1992; Robichaux & Adams, 1985).

- Urban schools with students participating in the NSLP wasted a larger percentage of food than suburban schools with students participating in the NSLP (USGAO, May 1996).

- Participants in the NSLP from urban schools wasted a larger percentage of the nutrients than nonparticipants (USGAO, May 1996).

- Participants in the NSLP receiving a free school lunch wasted a larger percentage of the nutrients than participants paying full price (USGAO, May 1996).

On a more local scale, a 2010 study completed by the Minnesota Pollution Control Agency found that the most prominent single material generated by schools was food waste, which accounted for 23.9% of the total waste generated (Cioci & Farnan). This study also found that younger students waste more than older students: Elementary school students (27% plate waste), middle school students (24% plate waste) and High School students (20% plate waste) (Cioci & Farnan, 2010).

Fiscal benefits of studying plate waste

The USDA's Economic Research Service reviewed studies on plate waste in school nutrition programs, particularly the NSLP, to determine inefficiency in the program. Specifically, how much food was wasted, what factors contributed to the plate waste, and strategies that may reduce plate waste. These studies were conducted between 1977 and 2001. The early studies were limited, focusing only on a handful of schools in a certain region. Plate waste estimates from these smaller studies ranges from 10 to 37%, indicating both local variations in plate waste and the different research methodologies (Guthrie et al., 2002).

The most comprehensive study to date occurred in 1991-1992, contained 3,350 students in grades one through twelve, and is the only nationwide study that assessed the nutrient content of food actually eaten AND the amount of food that went uneaten. It found that approximately 12% of the calories from school meals and up to 15% of the individuals nutrients were not being eaten (USDA, 2002). This results in an estimated direct economic loss of over $600 million (Dwyer, 1995, Guthrie et al., 2002). Plate waste is an important tool for analyzing fiscal success of food programs.

Ecological benefits of studying plate waste

Plate Waste studies are also useful when looking to reduce garbage volume and promote healthy environments. There has been a increasing interest in protecting the environment and sustaining natural resources which has increased the focus on finding the most effective ways to discard waste. Land filling is currently the most common method of disposing waste in the Unites State, however the reliance on landfills has decreased from 85% in 1989 to 69% in 2010 (EPA, 2014). The rate of recycling during this period increased three times to 24%. As waste disposal costs increase, operations directors are looking to reduce the amount of waste generated from their facilities and/or look to other methods of disposing waste.

One method for doing this is to analyze an organization's waste stream to identify types and amounts of waste from food service. A study completed in 2000 identified types and amounts of solid waste generated by a rural school foodservice program with an offer vs. serve option. Researchers collected the data at a foodservice facility shared by an elementary school and a high school in the Midwest. The facility served an average of 319 meals daily, including

breakfast and lunch, and discarded a total of 344 pounds of production waste during ten days

(Shankin et al., 2000). Plate waste constituted approximately 32% by weight and 9% by volume.

Of this production waste, packaging waste constituted approximately 68% and 91% by weight

and volume. Elementary students discarded significantly more plate waste and milk than the high

school students did. However, high school students generated more packaging waste per meal

than the elementary students. This may be because high school students purchased more than one

carton of milk or other food items.

In a similar study, East Baton Rouge Parish School System in Louisiana embarked on an

innovative recycling program when the City of Baton Rouge decided to stop providing free

waste collection services to schools. At the time of the decision, the school cafeterias were

producing 50% of the school district's garbage and the school board decided that the food

service operations should pay for half of the $150,000 bill. In an effort to avoid this massive bill,

the school system conducted a plate waste study to examine whether a new type of packaging for

milk would reduce the volume of waste generated by the cafeterias. The study results revealed

that serving milk in pouches cut the volume of waste created by the milk packaging by an

average of 70% (Hahn, 1997). By the end of the school year, the district had significantly

reduced the volume of waste and was recycling 30-35 tons of cardboard, five tons of steel, and

30 tons of paper every month (Hahn, 1997). Since fewer garbage dumpsters were needed at each

school, they were able to waive over $30,000 in garbage costs that year. Perhaps the success of

this and other recycling programs will motivate other school food service operations to embark

on future recycling programs to offset the garbage costs.

CHAPTER 3

METHODOLOGY

Design of Study

This descriptive research determined, using aggregated nonselective plate waste measurements, the characteristics of plate waste generated by 5th-8th grade schools visiting Eagle Bluff Environmental Learning Center in Lanesboro, Minnesota. As a residential environmental learning center schools participate in multi-day classes, eating their meals on-site from the Eagle Bluff kitchen. While in residence, schools participate in the **Food W**aste **I**n **S**chools **E**limination Program (FoodWISE), which aims to reduce cafeteria plate waste through sound educational and sustainable ecological practices both at Eagle Bluff and in a traditional school setting. The program accomplishes this goal in three ways:

- Serving meals with little to no packaging on reusable dinnerware.
- Educating students about their food choices and offering incentives for waste reduction efforts.
- Composting food waste.

Each school participating in the FoodWISE program is given a presentation by an Eagle Bluff staff member on the impact of food waste and suggestions for how to go about reducing food waste. "Take what you want to eat and eat everything you take," is a motto both students and adults are encouraged to follow during their meals. The Eagle Bluff staff member also explains the offer vs. serve philosophy. Additionally, if someone only wants to eat half of something, or would like a smaller portion, they are directed to communicate this to the kitchen

server. Finally, if a student is having trouble finishing a food item, they are encouraged to seek out an adult or fellow classmate to help them finish the food or drink item.

Motivational Strategies

Each school is given a plate waste goal they are motivated to stay under, which is calculated by taking 5% of the total school group size. For example, a group of 100 has a goal to stay under 5 lbs. of plate waste for the entirety of their stay (most groups are in residence for 2 ½ days which equates to 7 meals). Additional, during the FoodWISE orientation a school is made aware of several awards they can earn.

- Golden Clean-Plate: Awarded to schools that meet or remain under their plate waste goal.

- Zero-Heroes*: Awarded to those schools who achieve zero plate waste during their entire stay.

- Good-Effort Award: Awarded to schools that showed improvement (reduced the amount of plate waste) throughout their stay but did not meet or stay under their plate waste goal.

* Eagle Bluff staff members vary in their philosophy of mentioning this award during the orientation. Some will not mention it in an effort to avoid disappointment from schools/students that do not reach it and instead surprise them with this additional award should they earn it.

Additional Motivational Strategies

Some schools will additionally motivate their students beyond the Eagle Bluff awards given at the end of a group's stay. Although this list may not be all-inclusive, below are several known strategies that some schools choose to use:

- *Competitions between smaller groups*- schools bringing more than 20 students are broken into smaller groups for teaching purposes. Some schools set competitions between these smaller groups.

- *Competition between gender*- plate waste competition between boys and girls.

- *Competition from year to year* – although each school has access to a graph showing plate waste totals from previous years, some schools choose to motivate their students by constantly comparing them to a previous year and encouraging them to do better than them.

It is unknown if these additional motivational strategies have an impact on reducing the amount of plate waste a school produces during their stay, as they were not kept track of in this study. Nevertheless, it is worth noting that some schools have employed these strategies for many years.

Adult Chaperones

In addition to the students participating in the FoodWISE programs, any adult on the trip is also expected to do the same. Therefore, any plate waste from parent chaperones and teachers are included in a school's plate waste total. The number of adult chaperones accompanying a group is highly variable but generally follows a 10:1 student to adult ratio.

Participants

The sample consisted of 81 school groups participating in Eagle Bluff's Residential School Program. The schools came from Minnesota, Wisconsin, Iowa, and Illinois from cities

categorized as urban (50,000 or more people), urban cluster (at least 2,500 and less than 50,000 people), and rural (all population, housing, and territory not included within an urban area) as classified in 2010 by the US Census Bureau. Both public schools and private schools are included in this study. The majority of schools in this study only brought one grade level at a time.

The FoodWISE program was piloted with 14 schools during the 2005-2006 school year; this study does not use the plate waste results from this baseline year as methods and procedures were still being finalized. Beginning the following school year (2006- 2007), however, every residential school group participated in the FoodWISE program. This study analyses the amount of plate waste generated by 81 schools for 5 consecutive years between 2006 and 2015. We choose to analyze a school's plate waste for 5 years, rather than a single year, to help control for outliers with in a single year and to help control for differences in menu items from year to year. This subject is explored more in the "limitations" section of this paper. Therefore, those schools that do not have a five-year consecutive visit history were not used for this study.
Similarly, data were collected over 8 years in order to maximize the amount of schools involved in the study as Eagle Bluff gains and loses schools every year due to various reasons. But, to try and maintain consistency, whenever possible plate waste data were used beginning in the 2006-2007 school year. If a school was not present during the 2006-2007 school year, the 5 year data collections began with the first year the school attended Eagle Bluff. This was done to lower any bias that could result from teachers being overly familiar with the program (and thus using additional motivational methods). Most schools are in residence for 2.5 days for a total of 7

24

meals (2 breakfasts, 3 lunches, 2 dinners). In rare cases, schools are in residence up to 5 days or

only for one night; these schools are not included in this study.

Table 1: Study Sample

	Number of Schools in Sample
Grade	
5th	24
6th	19
7th	12
8th	15
Total:	**70***
School Location	
Urban	16
Urban Cluster	43
Rural	22
Total:	**81**
School Type	
Private	29
Public	52
Total:	**81**
Group Size	**81**

* 11 of the 81 schools bring multiple grades on their trip and therefore could not be used when analyzing plate waste by grade.

Menu and Kitchen Protocols

Menus change from year to year depending on the head chef, seasonality of foods, and a move at Eagle Bluff over the years to produce more scratch-made meals. Our chefs operate on a 2 week rotation of meals. When plating, dining hall staff use scoops, dishers, or ladles for consistency in portioning food. Guests have the option to have seconds on most food items after everyone in the dining hall has gone through the serving line once. For breakfast, guests can take as much fruit, yogurt, and granola from the self-service breakfast bar. During lunch and dinner, this self-service bar is filled with salad items. Drinks are self-serve style.

Procedure for data collection

School groups were given their own plate waste cart in order to collect plate waste and trash from a meal. When there was multiple schools in residence at the same time, we assigned a plate waste collection cart to each school in order to keep the plate waste separate. Each school was assigned an adult and students to "cart duty" to help their school sort and scrape their plate waste in the three containers: one for solid plate waste, one for liquid plate waste, and one for non-food waste (i.e. napkins) and/or inedible food items (i.e. banana peels). Once everyone from the school group finished eating, Eagle Bluff staff members weighed the plate waste from each school and recorded the amount in a logbook. The Non-food waste items or inedible food items were sorted for landfill or compost and were not included in this study.

A flat scale measuring pounds and ounces was used to weigh the plate waste. The weight of the bin storing the food was tarred and was not a part of the plate waste total. In addition to recording the amount of waste for each school, we also recorded the menu for the day and the

school's plate waste goal. At the end of a school's stay, the plate waste amounts for each meal were added up and recorded on a digital spreadsheet.

The number of people from each school (students and adults) was counted by the Eagle Bluff staff member and confirmed by the lead teacher from that school when recording for billing purposes.

Data analysis

Average plate waste per person for each school over 5 years was calculated by dividing ounces of plate waste by the number of people from the school group that year. Then, we averaged the five numbers.

Table 2: Example of how average plate waste per person was calculated for each school

Alice Smith School	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011
Ounces of plate waste	35	76	48	41	55
# of people	92	106	108	184	112
Plate waste per person	.38	.71	.44	.22	.49

Average plate waste per person over 5 years: .45 ounces

Statistical Analysis

The statistical analysis used was a form of descriptive statistics. Comparison of means was used because the data sample was group averages, not individual data for each participant.

Data were analyzed using the Statistical Package for the Social Sciences (version 23, 2015, SPSS Inc.). To examine the relationship between plate waste and group size (research objective 1) descriptive and frequency statistics were calculated. Due to the presence of outliers, the Spearman's rank-order correlation was conducted to assess the strength of the relationship between average plate waste per person and group size.

To analyze plate waste and school location (urban, urban cluster, rural) (research objective 2), schools had to first be classified into the different areas. The Census Bureau delineates urban areas after each decennial census by applying specified criteria to decennial census and other data. The Census Bureau identifies two types of urban areas:

- Urbanized Areas of 50,000 or more people
- Urban Clusters of at least 2,500 and less than 50,000 people.

"Rural" encompasses all population, housing, and territory not included within an urban area. Once each school was classified, descriptive and frequency statistics were calculated along with a Shapiro-Wilk's test for normality ($p \leq .05$). The range of plate waste based on the 95-percent confidence interval was calculated for each school location. Due to the presence of outliers and non-normally distributed data the Kruskal-Wallis H test was also conducted. Finally, pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons.

To examine plate waste between grades (5th, 6th, 7th, 8th) (research objective 3) descriptive and frequency statistics were calculated along with a Shapiro-Wilk's test for normality ($p \leq .05$). The range of plate waste based on the 95-percent confidence interval was calculated for each

grade. Due to the presence of outliers and non-normally distributed data the Kruskal-Wallis H test was also conducted.

When analyzing plate waste between school type (public schools vs. private schools) (research objective 4) descriptive and frequency statistics were calculated as well as t-tests were calculated along with a Shapiro-Wilk's test for normality ($p \leq .05$). The range of plate waste based on the 95-percent confidence interval was calculated for both school types. Due to the presence of outliers and non-normally distributed data the Mann-Whitney U test was also conducted.

To examine the relationship between plate waste and time (research objective 5) descriptive and frequency statistics were calculated. Due to the presence of outliers, the Friedman test was run to determine if there were differences in average plate waste per person for each of the 5 years data were collected. Pairwise comparisons were performed with a Bonferroni correlation for multiple comparison.

CHAPTER 4

RESULTS

Data Results

Research Objective 1

We examined the relationship between plate waste and group size. There was a strong positive

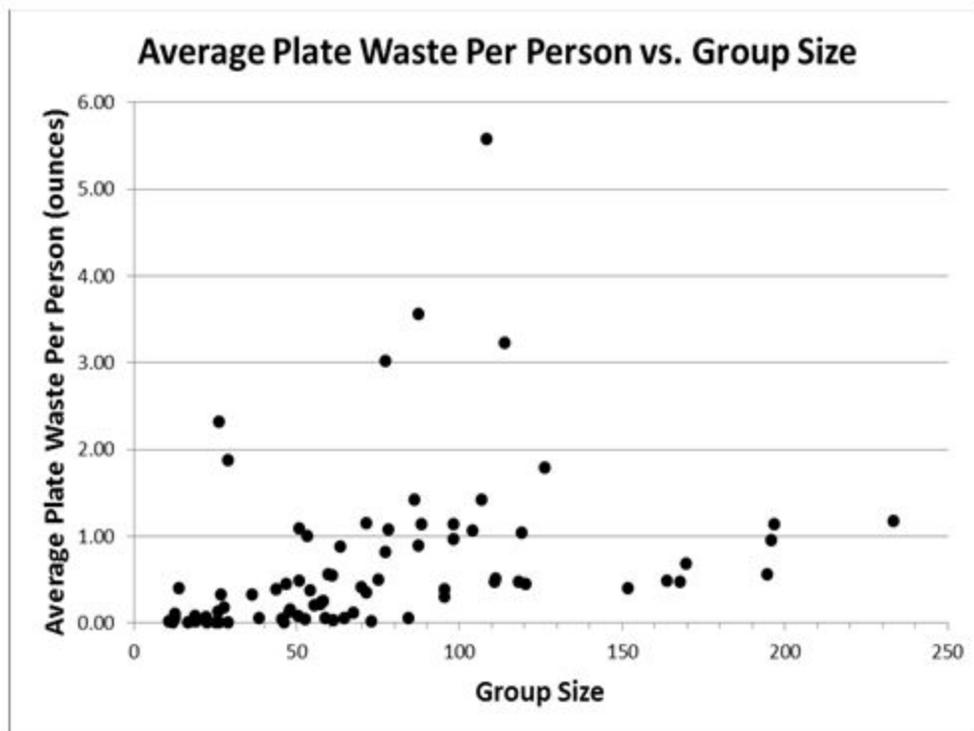correlation between average plate waste per person and group size (r_s (78)= .653, p <.0005).

Figure 1: There was a positive relationship between average plate waste per person and group

size.

Research Objective 2

We compared average plate waste per person by school location. Distributions of average plate waste per person by school location were not similar, as assessed by visual inspection. Figure 3 shows the mean plate waste per person as well as the range of plate waste based on the 95-percent confidence interval. Average plate waste per person was statistically significantly lower for rural schools (.185 ounces) than schools from urban clusters (.770 ounces) or urban areas (.944 ounces) ($x^2(2)$=20.131, p=.0001).
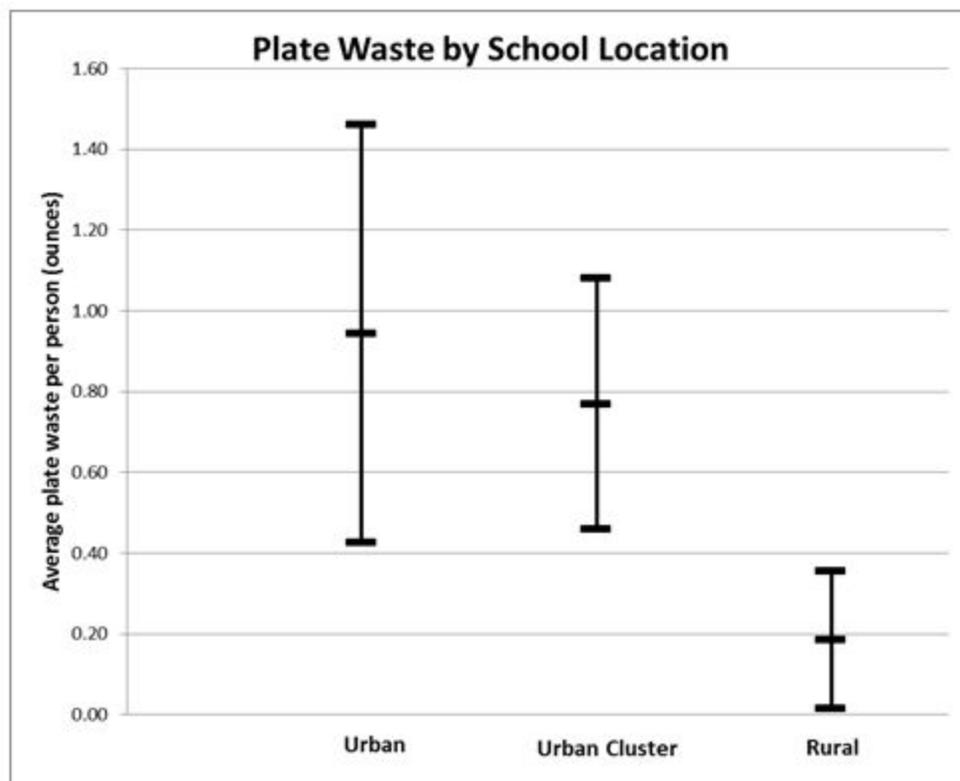

Figure 2: Groups from a rural school location wasted less plate waste than schools from urban and urban cluster locations.

Research Objective 3:

Plate waste by grade level (5th-8th) was analyzed to determine if there was a difference. Figure 1 shows the mean plate waste per person as well as the range of plate waste based on the 95-percent confidence interval. Distributions of average plate waste per person were not similar for all groups, as assessed by visual inspection. 6th graders had the highest average plate waste per person (.802 ounces) followed by 5th graders (.746), 7th graders (.561), and 8th graders (.396). Average plate waste per person, however, were not statistically significantly different between groups ($x^2(3) = 4.608$, p=.203).
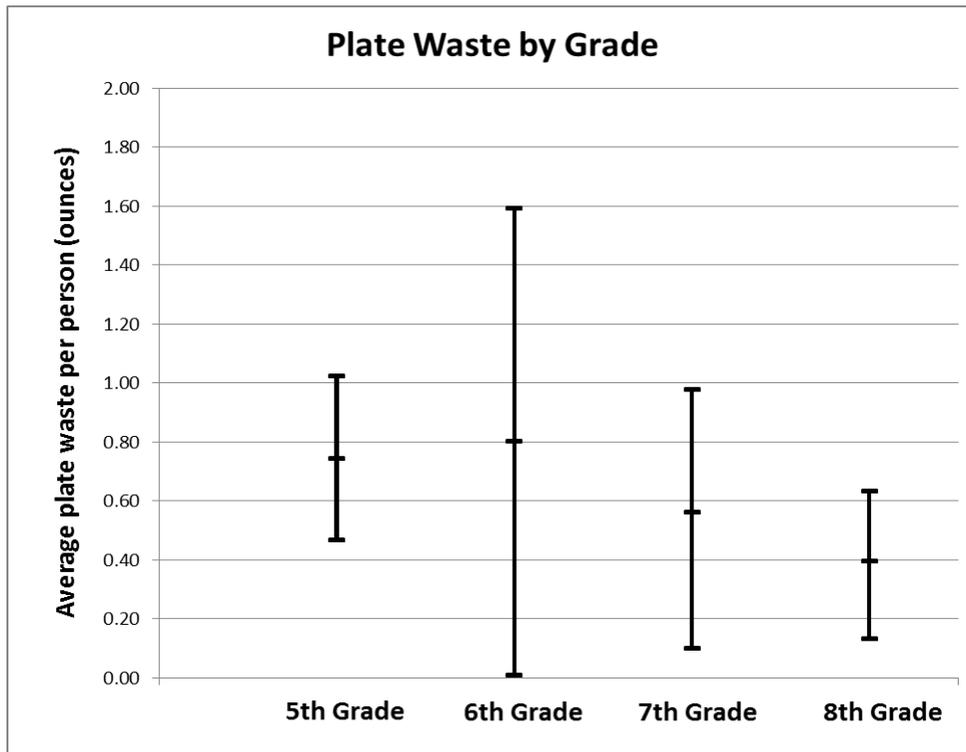

Figure 3: No Statistically Significant Differences in the Average Plate Waste per person by Grade

Research Objective 4

We compared plate waste by school type (public vs. private) to determine if there was a difference. Figure 2 shows the mean plate waste per person as well as the range of plate waste based on the 95-percent confidence interval. Distributions of the average plate waste per person for private schools and public schools were similar, as assessed by visual inspection. Average plate waste per person was statistically significantly higher in public schools (.80 ounces) than in private schools (.29 ounces), (U = 1,406, z=3.07, p = .002).
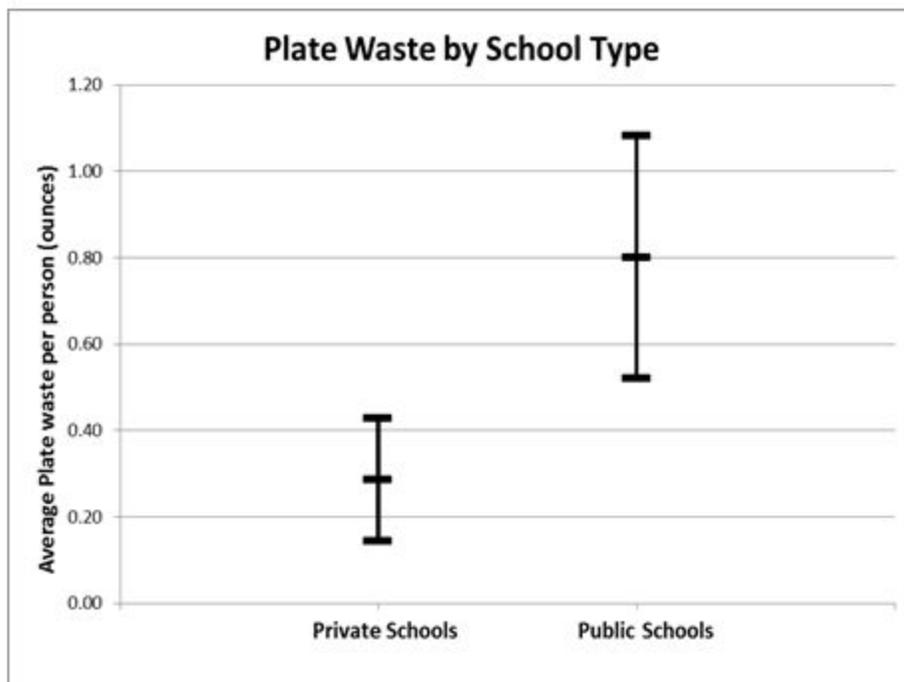

Figure 4: Groups from public schools had a higher average plate waste per person than groups from private schools

Research Objective 5

We examined the relationship between plate waste and time. Figure 5 shows the mean plate waste per person as well as the range of plate waste based on the 95-percent confidence interval. Average plate waste per person was statistically significantly different over the course of 5 years, $(x^2(4)= 20.54$ $p< .0005)$. Post hoc analysis revealed statistically significant differences in average plate waste per person from year 1 (Mdn = .3420) to year 5 (Mdn - .0400) (p < .002) and year 2 (Mdn = .1740) (p= .030) to year 5, but not between any other years.
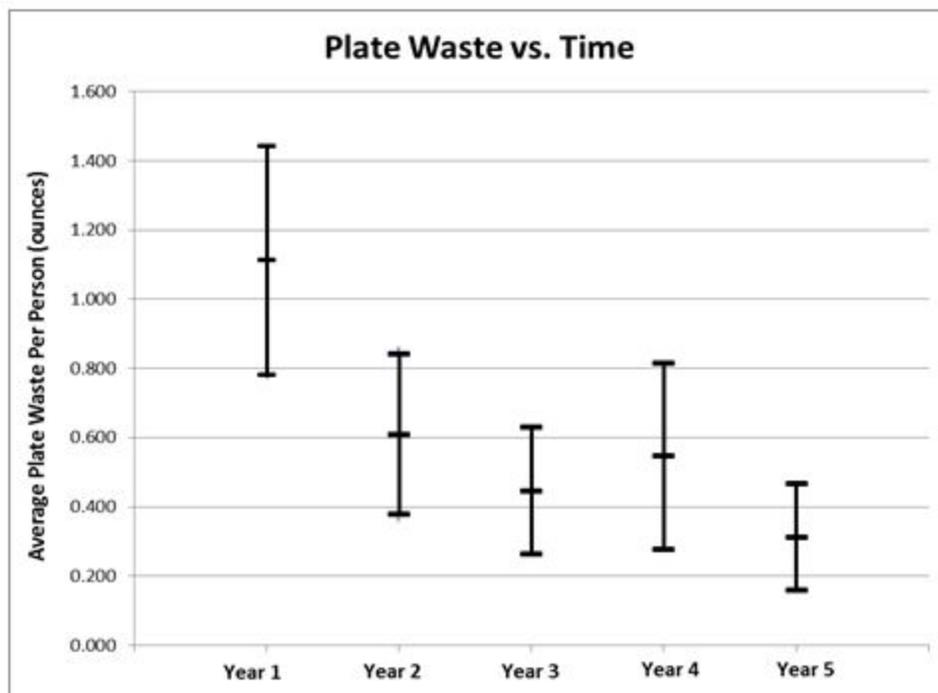

Figure 5: Average plate waste per person was highest during the first year of the study.

CHAPTER 5

CONCLUDING DISCUSSION

Summary

The purpose of this study was to determine and analyze trends in plate waste at a residential environmental learning center. Completely eliminating plate waste is unrealistic, but reducing plate waste lowers user costs, makes program operations more efficient, and enhances a program's success in meeting nutritional needs of children (Guthrie et al., 2002).

The research objectives of this study were (a) to examine plate waste between grades (5th, 6th, 7th, 8th), (b) to examine plate waste between private and public schools, (c) to examine plate waste between schools from rural, urban cluster, and urban locations, (d) to examine the relationship between plate waste and group size, and (e) to examine the relationship between plate waste and time.

A review of literature reveals that younger children tend to waste more food than older children (USGAO, May 1996, Dillon & Lane, 1989). Plate waste varies by food type, with salad, vegetables, and fruit generally reported to be the most wasted items (Bark, 1998; Reger et al., 1996; USGAO, July 1996; USDA/FNS, 1992; Robichaux & Adams, 1985). Urban schools with students participating in the NSLP wasted a larger percentage of food than suburban schools with students participating in the NSLP (USGAO, May 1996).

This descriptive research determined, using aggregated nonselective plate waste measurements, the characteristics of plate waste generated by 81 groups of 5th, 6th, 7th, and 8th grade schools visiting Eagle Bluff Environmental Learning Center in Lanesboro, Minnesota over

the course of 5 years. Descriptive statistics were used to compare average plate waste per person for each group.

Conclusions

Research Objective 1: To examine the relationship between group size and average plate waste per person. The results of this study found a positive relationship between group size and average plate waste per person. This could be because with larger groups, there is less accountability when it comes to plate waste. At Eagle Bluff, several students and an adult are scheduled to be on "cart duty" to help sort plate waste when people are done eating and to gently encourage people to eat as much food as they can before placing it into the sorting bins. With smaller groups, people tend to come up to the cart one by one which makes it easier for the people on cart duty to gently encourage them to eat more; there is more peer pressure and attention placed on the individual. With larger groups, there are often many people at the cart at once which decreases the one on one attention and encouragement to try and finish their food. This could be a contributing factor to the positive relationship between group size and average plate waste per person.

Research Objective 2: To examine differences in average plate waste per person between schools from urban, urban cluster, and rural areas. There was not a statistically significant difference between the average plate waste per person from schools from urban and urban cluster locations. Figure III illustrates the statistically significant difference between the average plate waste per person from schools from a rural location and those schools from urban and urban

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cluster locations. There was not a statistically significant difference between the average plate waste per person from schools from urban and urban cluster locations. This finding is simlar to the May 1996 USGAO study which found that students from urban schools participating in the National School Lunch program wasted a higher percentage of plate waste than participants from schools found in urban cluster locations.

To ensure there was no extraneous variable acting on these data, we controlled for group size among each school location. We still found that rural schools had statistically significant differences between the average plate waste per person from urban and urban cluster schools.

Research Objective 3: To examine differences in average plate waste per person between grade levels (5th, 6th, 7th, 8th). The data analysis in this study indicated that 6th graders had the highest average plate waste per person followed by 5th graders, 7thgraders, and 8th graders. With the exception of the 6th graders, the results presented here are consistent with many studies which found that younger children waste a higher proportion of their food and nutrients than older children (Carver & Patton, 1958, Dillion & Lane, 1989, USGAO, May 1996, Bark, 1998, and Tran, 2009). Even though the results are not statistically significant, we decided to take a closer look at the overall demographics of the 19 schools used in the analysis of plate waste from 6th grade to see if any extraneous variables were contributing to the high average plate waste per person. High average group size does not appear to be the cause, as the 7th graders had the highest average group size (83 people) followed by 5th graders (76 people) then 6th graders (73 people). Next, we looked at school location (urban vs. urban cluster vs. rural) since there was a statistically significant difference between urban and urban cluster school location and rural

location. Of 6th grade schools represented in this study, 79% of the schools are representatives of urban/urban cluster schools, which had statistically significantly higher average plate waste per person than rural schools. This is the highest percentage of urban/urban cluster schools for each of the grade levels (5th grade had 75% of schools come from urban/urban cluster areas, 7th had 51% and 8th had 60%.) This could account for the unexpectedly high results from the 6th graders in this study.

Younger students may waste more food because they are still be being socialized to eat within a school setting, while older students are more independent consumers. Also, it may take younger students a longer amount of time to consume their meals than older students. Other factors that could contribute to this trend are portion sizes. Our dining hall does adjust portion size for different ages but perhaps some adjustment is still needed to ensure the lower plate waste. Younger students may also be worse at judging their hunger or acceptable portion size especially when it comes to taking the self-serve items in the breakfast or salad bar which could contribute to higher plate waste from the younger students.

Research Objective 4: To examine differences in average plate waste per person between public and private schools. Average plate waste per person was higher for public schools than for private schools. No known research on this specific demographic. One reason we identified that could be responsible for the significant difference is the size of the group. The average group size for private schools is 43.4 students (with a maximum group size of 84.6 and a minimum group size of 10.8). For public schools, the mean group size is 86 (with a maximum group size of 233.6 and a minimum group size of 23.0). After analyzing research objective 1, we know that

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there is a strong correlation between group size and plate waste ($r_s(78) = .653$). Because of this, we controlled for group size and still found the public school groups wasted more plate waste the private school groups.

Research Objective 5: To examine differences in average plate waste per person over time. When we analyzed average plate waste per person for each of the five years the school visited, we found that there was a statistically significant difference between year 1 and year 5. One reason why we believe this trend may have appeared is because of the inexperience of the school staff when dealing with Eagle Bluff's dining hall procedures and the FoodWISE program. Once the teachers have a year of experience they are better equipped to prepare their students for the trip. This is especially true in regards to the serving policies. Unlike many school cafeteria policies which require students to take a certain number of entrée items, Eagle Bluff does not require this; students may opt out of taking any food item or can ask for half of something.

As will be discussed in the Limitation section of this paper, some schools will also choose to practice limiting food waste at their school before coming to Eagle Bluff. This is most likely to happen after their first year, once the teachers understand how the program works. This practice may help reduce plate waste for future years.

Limitations

Despite plate waste being a "hot topic" right now, there is limited large-scale studies about current plate waste trends. The most recent, national study of plate waste in school

lunchrooms was conducted more than 20 years ago. This may be because collecting accurate plate waste data (via direct measurement with a scale or visual estimation) is labor intensive and becomes increasingly unmanageable as sample size grows.

Each school group that comes to Eagle Bluff is assigned a staff member to act as a liaison or host during their stay. This person is responsible for teaching the school group about the FoodWISE program then monitoring the program throughout their stay. Although staff members receive the same training about how to run this program there are probably slight difference in how they present the program along with differences in how staff members motivate their group to try and achieve their goal throughout their stay. This could impact a student's mindset when choosing what or how much food to take in the food service line.

The teachers who come with their school may also have an impact on their group's plate waste. If a teacher has been to Eagle Bluff before, and is therefore familiar with the FoodWISE program, they may have additional strategies for trying to motivate students to reduce their plate waste. Also, some teachers have their class practice limiting plate waste at their own school before coming on the Eagle Bluff trip in hopes that the students will be more familiar with the goals and process of plate waste collection. Groups who practice ahead of time may have lower amounts of plate waste than those groups who do not practice ahead of time.

Another limitation of this study concerns the food service consistency over the length of time the data were taken. This study looks at plate waste data from 2006 through 2015. Over the course of this time, we have had several head chefs who are responsible for putting together the menu. It is possible that differences in plate waste could be because of preferences for certain menu items. We acknowledge this limitation but choose to analyze the data over 8 years in order

to maximize the amount of schools involved in the study as Eagle Bluff gains and loses schools every year due to various reasons. Whenever possible plate waste data were used beginning in the 2006-2007 school year to try and account for this chef/menu difference.

Finally, although the cooks and servers use measuring spoons, cups, and serving containers when plating meals, there is likely some portion variation by the kitchen staff when serving throughout the years.

Summation of Possible Successive Research

The following list details possible research that could be carried out based in part, upon the data collected in this study.

1. The relationship between meal type and food waste. In addition to collecting plate waste results for the past 8 years, we have also recorded the menu for each meal.

2. The relationship between the percentage of students on the free/reduced meal program and amount of plate waste per person. We think this area is of particular interest because students participating in the NSLP are required to take a certain number of items off the menu, even if they have no intention of eating those items. At Eagle Bluff, we do not require this so the student have to quickly change their mindset to avoid wasting food they do not want to eat.

3. Those schools who practice the FoodWISE program prior to coming to Eagle Bluff and those who do not.

4. Those schools who utilize the additional motivational strategies for reducing plate waste.

Implications

Although plate waste is inevitable, excessive waste implies inefficiencies in food service procedures and that students may not be receiving the proper nutrients. Many schools struggle with excessive plate waste and, as such, recommendations have been identified to try and reduce plate waste. In 2002, Buzby and Guthrie, in a final report to Congress, identified the following strategies were to help reduce plate waste in schools:

1. Using the offer vs. serve provision for meal service

2. Rescheduling lunch hours until after recess

3. Improving the quality and condition of food

4. Tailoring serving sizes to student appetites via self-service

5. Providing nutrition education

Eagle Bluff Environmental Learning Center follows these five recommendations. The results of this study, though, will be helpful the food service staff to tweak an already efficient food service program. It will also be helpful to the Eagle Bluff staff member assigned to liaison for that school. For example, knowing that first year school tends to waste more than a 5th year school can help them tailor their FoodWISE program introduction to make it more thorough or perhaps give examples to help them understand how to make choices when they are in the food service line. There are also plans to have this information displayed in the Eagle Bluff dining hall for groups to look over as they wait in line for their meal.

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