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DOCUMENTING THE DELTA:
LESSONS LEARNED FROM FILM

A Thesis

Presented to

The Faculty of the Department of Environmental Studies

San José State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

Charise L. Parker

May 2012

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The Designated Thesis Committee Approves the Thesis Titled

DOCUMENTING THE DELTA: LESSONS LEARNED FROM FILM

by

Charise L. Parker

APPROVED FOR THE DEPARTMENT OF ENVIRONMENTAL STUDIES

SAN JOSÉ STATE UNIVERSITY

May 2012

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ABSTRACT

DOCUMENTING THE DELTA: LESSONS LEARNED FROM FILM

by Charise L. Parker

California's Sacramento-San Joaquin Delta, "the Delta," is one of the state's most important natural resources. Beginning in the mid 1800s and continuing to the present day, anthropogenic activities radically altered, and continue to affect, this ecosystem. Wetland reclamation and water projects transformed the Delta landscape from a tidal wetland into an artificially homogenous freshwater system. As a result, the health of the Delta ecosystem is in jeopardy. Experts agree that current management practices of the Delta are unsustainable; however, experts cannot agree on a viable solution.

An educational documentary film, "California Kings: Sold Down the River," was used as the treatment in experimental groups for this study. The film covered key social, political, economic, and environmental issues regarding the Delta ecosystem. This thesis work evaluated the film's effect on viewer knowledge levels, personality factors (attitudes, locus of control, personal responsibility), perception of threat, and behavioral intentions concerning the Delta. The sample population consisted of environmental studies and non-environmental studies students at San José State University, California. Regardless of major, student pro-environmental responses shifted towards the producer's goal of increased sensitivity towards the Delta ecosystem. Environmental education (EE) films which include divergent opinions from multiple stakeholders can be effective at increasing pro-environmental responses from viewers.

ACKNOWLEDGMENTS

I must first thank Patrick Ferraro. It was in his Western Water Policy class in August of 2009 that I found my passion for California's water resources. I remember the assignment that planted the seed for "California King's: Sold Down the River"--an essay Pat asked the class to write on the proposed Peripheral Canal. While researching this topic, I realized that someone *must* make a documentary film about what was happening to California's water resources. A week later, I was involved in the production of such a film. I am grateful to Michael Pawlawski, the Executive Producer of this film, for the opportunity to be a part of this production. We made a great team and I will always cherish the memories.

I must thank each and every person who volunteered their time and expertise to help with this film. Many thanks to Bruce Tokars, Carollee Krieger, Lloyd Carter, Bill Kier, Dr. Jeffrey Michael, Dr. Peter Mount, Dr. William Bennett and Dr. Tina Swanson, to name only a few.

I also want to thank my thesis committee for guiding me through my research, document production, and defense. Dr. Trulio, Dr. Russell, and Terry Trumbull--you have been so instrumental in my thesis experience. I especially want to thank you all for granting me an early defense to accommodate my sudden move back to Florida.

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Introduction

Background

According to the Public Policy Institute of California (2007), television is the most common source of environmental information for Californians of all ages, levels of education, and economic status. Television sources include nature documentary films, public affairs programming, and broadcast journalism. Research efforts in the field of environmental education (EE) have evaluated the importance of television in promoting pro-environmental responses from learners (Fortner, 1985; Ostman & Parker, 1986; Holbert, Kwak, & Shah, 2003). Nature documentaries and public affairs programming have been shown to influence the affective and cognitive components of viewer attitudes (Fortner, 1985; Holbert et al., 2003). Prior EE research has shown that educated segments of the population found broadcast journalism biased, sensationalized, and unreliable because media personnel tended to report only the viewpoint they wished to advocate (Ostman & Parker, 1986). However, there is no prior research for EE documentary films that target the cognitive components of attitude (beliefs) *and* the affective components of attitudes (emotions) while portraying multiple viewpoints. Research on how documentary films, with all these elements, can influence viewer pro-environmental responses is crucial for the field of EE.

California's Sacramento-San Joaquin Delta, "the Delta," provides an opportunity to test research questions about EE films and pro-environmental responses from learners. A documentary film, "California Kings: Sold Down the River," was produced for

purpose of educating the general public on the environmental issues surrounding the Delta and the salmon population which depends on this ecosystem for survival. The film includes multiple viewpoints from stakeholders on all sides of the issue and targets viewer beliefs and emotions in an effort to influence pro-Delta attitudes and behavioral intentions.

California's Delta

Approximately 50 miles east of San Francisco Bay sits California's Sacramento-San Joaquin Delta, "the Delta," a triangle of farmlands and waterways spanning nearly 600,000 acres. In the Delta, the state's two great rivers, the Sacramento and the San Joaquin, converge on their journey to the San Francisco Bay (PPIC, 2007; Strange, 2008; Norgaard et al., 2009). As an integral component of the San Francisco Estuary and one of the state's most ecologically important landscapes, the Delta provides critical habitat for many endemic species (Delta Vision, 2007). Fish and migratory birds are dependent on the Delta ecosystem (Norgaard et al., 2009); over 700 species of native flora and fauna find refuge in the Delta (DFG, 2010). Moreover, approximately 80% of the California salmon fishery, which is second only to Alaska, depends on the Delta's habitat for survival (Strange, 2008); the Delta smelt, a small resident fish in the Delta, is found nowhere else on earth (DFG, 2010).

The Delta's rich habitat also sustains California's residents in various crucial ways. Recreational activities in the Delta, such as water skiing, kayaking, fishing, and bird watching, support the state's tourism industry. Many of the state's last small farm operations occupy the Delta, along with the families who have worked the land for

multiple generations. In recent years, the Delta's tourism and agricultural industries contributed an estimated $5 billion to California's economy (Levine, 2010).

Most of the water for California's expansive water conveyance system, which includes the Central Valley Project (CVP) and the State Water Project (SWP), flows through the Delta. Over two-thirds of the state's population relies on the Delta to meet some or all of their drinking water needs (Delta Vision, 2007; Strange, 2008; Norgaard, Kallis, & Kiparsky, 2009). Agribusinesses in the Central Valley and western San Joaquin Valley also depend on Delta water exports for the survival of their crops (DWR, 2010). The agriculture sector in California, which accounts for approximately 1.5% of the state's GDP (USBEA, 2011), receives over 80% of California's developed water resources (Pacific Institute, 2008).

Experts and stakeholders agree that the Bay-Delta ecosystem is in serious decline and that current management practices of this natural resource are unsustainable (PPIC, 2007; Moyle, 2008; Strange, 2008; Zetland, 2010). The Delta's natural environment has dramatically changed since the construction of the CVP and SWP (see Appendix 1), leading to unfavorable conditions for native fish species. Within the last 50 years, native fish species, including the thicktail chub *(Gila crassicauda)* and the Sacramento perch *(Archoplites interruptus*) have gone extinct. Other species, including four runs of Chinook salmon (*Oncorhynchus tshawytscha*) and the Delta smelt (*Hypomesus transpacificus*), have experienced severe declines in numbers. In total, five native fish species are threatened or endangered according to state and federal endangered species acts (Moyle, 2008). Multiple forces jeopardize these native fish species, including

polluted runoff from agricultural and urban activities, invasions of alien species, and climate change (see Appendix 1). However, experts frequently cite heavy water exports from the southern Delta as the principal force leading to massive declines in native fish populations (Moyle, 2008; PCFFA, 2009; Bacher, 2010; CSFPA, 2010).

The Delta also faces formidable threats due to its poorly built, 1,100-mile long levee system. Beginning in the 1880's, Chinese immigrants constructed these levees--devoid of modern engineering principles--on a foundation of weak sand and peat soils; over time, the system expanded in a haphazard fashion (Sze et al., 2009). These levees provide the sole source of flood protection for approximately 60 below sea-level "islands" which support residential and agricultural uses; the levees are vulnerable to failure from seismic activity, winter storm-induced flooding, and sea level rise (PPIC, 2007). If these levees fail, an estimate of $50 billion in property losses could occur and Delta residents would find their homes and livelihoods underwater. More critically, salt water from the San Francisco Bay would be pulled eastward into the Delta, compromising drinking water supplies for 22 million Californians for up to 1.5 years (Levine, 2010)--a catastrophic prediction. Agricultural users would also be in trouble; over 70% of CVP water deliveries and 30% SWP deliveries provide irrigation for farmlands (USBR, 2010; DWR, 2010).

Groups of stakeholders dependent on the Delta favor distinct strategies for dealing with the current state and uncertain future of this natural resource. Delta residents, urban water users, agricultural interests, and environmentalists have fought over Delta management for years; these groups often have opposing opinions on management.

Other important factors, including substantial fiscal investments and the complexity of the Delta's fragile ecosystem, have hindered the resolution of problems within the Delta. Economists have described the conflict over the Delta in terms of Zero-Sum Game Theory, which posits that this adversarial dilemma cannot be resolved via a voluntary agreement because a "win-win"' solution does not exist. Should one group receive its desired outcome, other groups will inevitably have to compromise and forfeit some or all of the resources (Hanemann & Dyckman, 2009; Zetland, 2010).

The preferred course of action for many Delta residents is to protect existing farm operations via repair and maintenance of failing levees and, at the same time, maintain water exports from the Delta (PPIC, 2007; Zetland, 2010). However, the "estimated capital costs" of this option are likely to exceed $6 billion (Zetland, 2009, p. 24) and would do little in the way of improving conditions for native fisheries (Moyle, 2008). Furthermore, sea level rise and increased snowmelt runoff due to climate change may jeopardize Delta water supplies in spite of repaired and re-enforced levees (PPIC, 2007; PPIC, 2008).

Agricultural water users in the Central Valley are inclined to favor new infrastructure that will store and convey water, such the Peripheral Canal (Zetland, 2010). The Peripheral Canal would pump water from the Sacramento River near the city of Hood and convey it around the Delta directly to Clifton Court Forebay; from there, the water would flow through CVP and SWP aqueducts and canals (Walker & Storper, 1979; PPIC, 2007). The Peripheral Canal would deliver freshwater at a rate of up to 15,000 cubic feet per second to 25 million residents (CSFPA, 2009). During the 1982 election,

Proposition 9 proposed this very infrastructure; however, Californians soundly rejected this ballot measure. Delta residents, Northern Californians, environmentalists, and even two prominent agribusinesses in the Central Valley strongly opposed the Peripheral Canal nearly 30 years ago, as do many stakeholders in these groups today (Gwynn & Thompson, 1984; Zetland, 2010).

However, the Peripheral Canal has many proponents, such as former Governor Schwarzenegger, who believe it is the solution for the state's water supply issues (PPIC, 2007; Delta Vision, 2009). The economic costs of a Peripheral Canal range from $5 billion (Zetland, 2010) to as high as $26 billion (Business Forecasting Center, 2008). While environmental costs for this option are hard to calculate (PPIC, 2007; Business Forecasting Center, 2008), some experts agree that native fisheries may not recover if the Peripheral Canal is constructed (PPIC, 2007; Zetland, 2010).

Environmental groups generally prefer one of two options: 1) restoration of the radically altered Delta closer to its natural condition (Zetland, 2010), or 2) charging agricultural interests the full cost of water exports (Terry Trumbull, Personal Communication, January 30, 2012). Restoration of Delta wetlands would cost approximately $1 billion each year (Zetland, 2010). In order to accomplish this goal, serious reduction or complete elimination of water exports from the Delta would be required. Under the unlikely scenario of complete elimination of Delta exports, would-be users of Delta water could see their supply drop by 6 million acre-feet per year. These users would face the replacement costs for reclaimed and/or desalinized water or the opportunity costs of diminished water supplies (Business Forecasting Center, 2008;

Zetland, 2010). Economists predict the cost of reduced water exports from as low as $4.25 million (Business Forecasting Center, 2008) to as high as $5 billion per year (Zetland, 2010). However, some economists consider the potential impact of ending Delta exports to be minimal, accounting for less than 0.03% of the state's current economy (Business Forecasting Center, 2009).

Furthermore, environmental groups generally prefer "that water be used within its watershed," since large amounts of energy are used to transport water between watersheds (Zetland, 2010, p. 24). Such demand for energy and consumptive use of fossil fuels is the leading cause of ever increasing greenhouse gasses in the atmosphere (Tillman, 2001), and contributes greatly to the carbon footprint on the environment (Khan & Hanjra, 2009). Currently, the energy costs of pumping Delta exports hundreds of miles south and over the Tehachapi Mountains is around 3,000 kWh per acre-foot of water (Business Forecasting Center, 2009). An estimated 20-28% of California's overall energy use is expended on pumping and conveying water from source to destination (Terry Trumbull, Personal Communication, January 30, 2012). The environmental and economic costs of pumping water south from the Delta have caused environmentalists and economists alike to question the construction of a Peripheral Canal (Business Forecasting Center, 2009; Zetland, 2010).

Environmentalists also favor the elimination of subsidies on Delta water exported for agricultural interests (Terry Trumbull, Personal Communication, January 30, 2012). According to a 1985 study completed for the Natural Resources Defense Council, Westlands Water District—the largest agricultural irrigation district in America—

received annual subsidies of nearly $500,000 a year and paid only 10% of the actual cost of water exports (LeVeen & King, 1985). A more recent report by the Environmental Working Group estimated that annual water subsidies to Westlands farmers amounted to $24 million, while power subsidies to convey that water reached as high as $71 million (Sharp & Walker, 2007; Carter, 2010). Environmentalists believe that elimination of subsidies on Delta water exports would substantially reduce water use by the agricultural sector—which uses approximately 80% of California's developed water resources (Carollee Krieger, Personal Communication, July 10, 2010; Terry Trumbull, Personal Communication, January 30, 2012).

An Opportunity for Environmental Educators

According to a statewide survey of 2,500 California residents, conducted by the Public Policy Institute of California, only 12% of respondents followed the state's environmental issues closely, and only 21% of respondents claimed to be knowledgeable about those issues (PPIC, 2002). Furthermore, a three-year study by the National Environmental Education and Training Foundation (NEETF) revealed that incorrect environmental information strongly persuades 80% of individuals (NEETF, 2002-2004). This study also found that there was "little difference in environmental knowledge levels between the average American and those who sit on governing bodies… whose decisions often has wide ramifications on the environment" (NEETF, 2002-2004, p. 8). Therefore, environmental educators have the opportunity to inform the public on the depth of California's water crisis.

Motivation

According to Bowman and Hanaford (1977), mass media efforts have long played an integral role in inducing public concern over environmental issues. Audiovisual media, including television news programming, nature documentaries, and commercial movies, have gained popularity as teaching media used to relay environmental information to the public (Murphy, 1993). According to Gellhorn's review (1991), the foundational precept of the First International Environmental Film Festival was that "film and television have the greatest potential for activating environmental change" (p. 12). Further research, which focuses on how documentary films can influence pro-environmental responses from viewers, is necessary for the field of EE.

Literature Review

This study strives to answer the questions: How can environmental educators design documentary films that effectively influence viewer pro-environmental responses? Which factors should environmental educators target through documentary films? Research in the fields of environmental behavior research, EE, and EE through film played key roles in this thesis work.

Predictors of Pro-Environmental Action

As stated in the Tbilisi Conference Declaration, the key objectives of Environmental Education (EE) are to foster awareness, increase knowledge, influence attitudes, promulgate necessary skills, and encourage participation among all people in the matter of resolving environmental problems (UNESCO, 1978). Simply stated, the

overarching goal of EE is to elicit pro-environmental behaviors from individuals (Hungerford & Volk, 1990; Darner, 2009). Several researchers in the field of EE examined theoretical models to explain the relationship among knowledge, attitudes, intentions, and actions (Hines, Hungerford & Tomera, 1986; Hungerford & Volk, 1990; Cottrell & Graefe, 1997; Jurin & Fortner, 2002; Forsyth, Garcia, & Zysniewski, 2004; Homburg & Stolberg, 2006; Story & Forsyth, 2008). Appendix 2 provides a summary of EE literature and the key variables thought to influence desirable outcomes. While there is no consensus on an optimum model for predicting desirable outcomes (Hines et al., 1986; Cottrell & Graefe, 1997; Darner, 2009), several findings in the literature indicate that knowledge, personality factors (such as attitudes, locus of control, and personal responsibility), and perception of threat influence pro-environmental responses.

Knowledge and Attitudes

In their 1976 study, Ramsey and Rickson investigated the relationship between student attitudes and knowledge with respect to environmental issues. They specifically examined how knowledge of ecology and knowledge of trade-off costs for pollution abatement related to differing attitudes among high school seniors in Minnesota. Under the premise that many preceding researchers assumed a relationship existed among knowledge, attitudes, and behavior, the authors acknowledged that an in depth look at how these variables related to one another was central to their current study. They found that, "…whether attitudes lead to increased knowledge or the other way around is not clear, but probably the two variables interplay: elementary knowledge leads to attitudes which in turn motivate one to learn more and so on" (Ramsey & Rickson, 1976, p. 11).

Such findings suggest the existence of a positive feedback loop between attitudes and knowledge. However, variation in student attitudes suggested that variables other than knowledge also influence responses to environmental information. Since "non-rational emotion factors" influence attitudes, human behavior cannot be fully predicted (Ramsey & Rickson, 1976, p. 14). In addition, the researchers found that knowledge of either ecological or economic concepts seemed to lead to moderate positions on both pollution abatement and consideration of tradeoff costs. Ramsey and Rickson (1976) concluded that, "diffusion of knowledge of all sides of an issue is a moderating influence" (p. 17).

Pooley and O'Conner (2000) further explored the role attitudinal variables play in environmental behavioral research and concluded "…one of the most important determinants of behavior is attitude" (p. 712). The authors advised educators to target emotions and beliefs, which influence attitudes, rather than knowledge levels, to achieve desired behaviors from learners.

The Model of Responsible Environmental Behavior

In their meta-analysis of research on environmental behavior completed after 1971, including Ramsey & Rickson's (1976) study, Hines et al. (1986) identified key variables most strongly associated with responsible environmental behavior and they developed the Model of Responsible Environmental Behavior (see Figure 1). The results of their study show that knowledge of issues and action strategies, action skills, personality factors, and situational factors, can all influence an individual's behavior

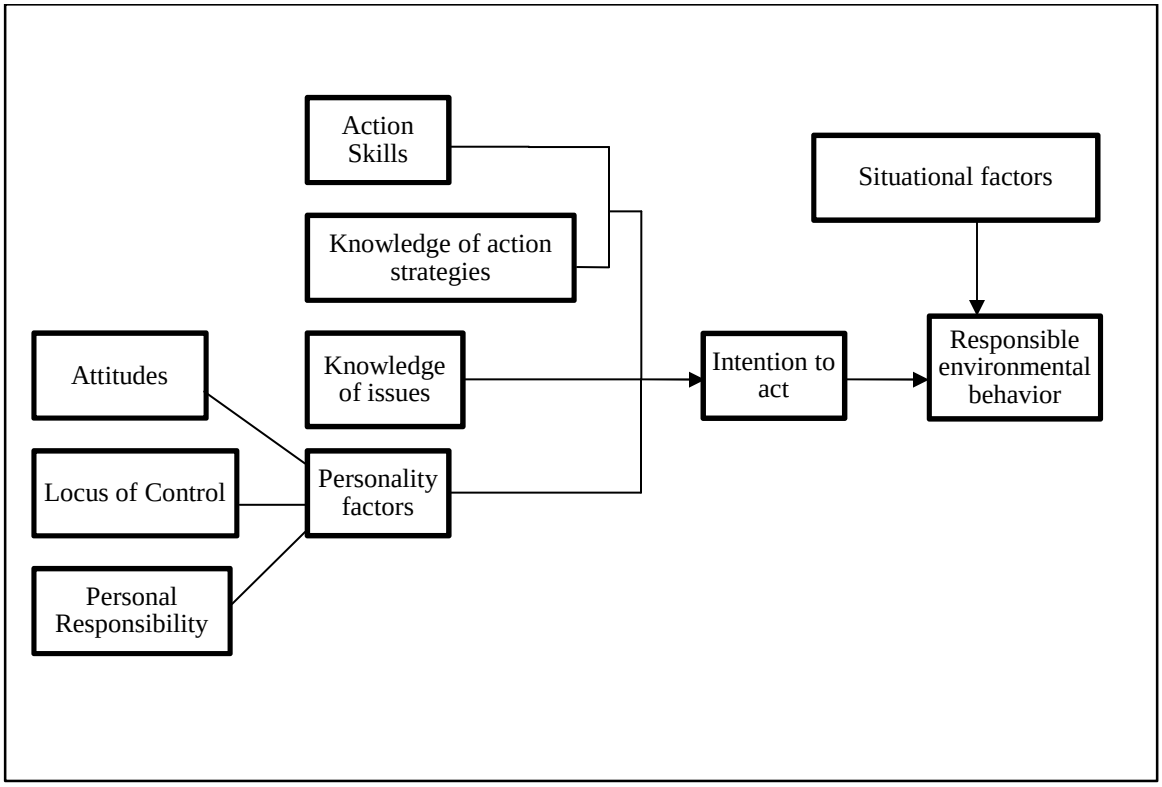

Figure 1: Model of Responsible Environmental Behavior (Hines et al., 1986)

towards the environment. Multiple variables interact with each other, and therefore, "the prediction of behavior is an extremely complex process" (Hines et al., 1986, p. 8). Despite the complexity of the relationship among these factors, the authors found that certain variables tend to precede others; before a person can act, he/she must "…be cognizant of the existence of the problem" (Hines et al., 1986, p. 6). Furthermore, an individual must also "…possess a desire to act," a virtue influenced by personality factors (Hines et al., 1986, p. 7).

Locus of Control and Personal Responsibility

In their analysis, Hines et al. (1986) considered how personality factors, including attitude, locus of control, and personal responsibility, can influence pro-environmental outcomes. They found a positive relationship between individuals who expressed pro-environmental attitudes and individuals who engaged in pro-environmental behaviors. Hines et al. (1986) also assessed locus of control, a personality factor that "…represents an individual's perception of whether or not he or she has the ability to bring about change through his or her own behavior" (Hines et al., 1986, p. 4). Results showed that individuals who believed their personal behaviors could bring about a desired change were more likely to have engaged in responsible environmental behaviors compared to individuals who believed their own behaviors could not make a difference. Lastly, the authors concluded that those individuals who felt a sense of personal responsibility towards the environment were more apt to act in an environmentally conscientious manner compared to individuals who lacked this personality factor (Hines et al., 1986).

Hungerford and Volk (1990) related environmental behavior research to EE programs; specifically, they examined the effectiveness of EE for promoting responsible environmental behaviors. They found that in order to promote desired outcomes, educators must understand that "…all environmental behavior is somehow issue related," and that "…*issues must be the focus of instruction* [emphasis added] beyond environmental sensitivity, ecological foundations, and issue awareness" (Hungerford & Volk, 1990, p. 17).

Hungerford and Volk (1990) further concluded that environmental educators "…are faced with a set of objectives that paint a broad picture of behavior encompassing not only knowledge, attitudes, and skills, but also active participation in society" (p. 9). They found that a prerequisite for advancement of active social participation is the development of a sense of ownership and locus of control in the learners towards environmental issues (Hungerford &Volk, 1990).

The results of Diduck's research expand on the findings of previous researchers. Ramsey and Rickson (1976) supposed a positive feedback loop of attitudes and knowledge shapes learner behavior; Diduck (1999) found that as students participate in environmental issues, they become more competent on those issues, and consequently express stronger intentions to become further involved. As their level of involvement increases, their sense of personal efficacy increases, leading to a stronger sense of personal responsibility. This strengthened sense of responsibility influences one's attitude, which further reinforces feelings of self-efficacy. Diduck's research (1999) also supports the Model of Responsible Environmental Behavior developed by Hines et al. (1986), in that several variables interact with each other in a complicated process.

Other Models Linking Key Factors

Later research tested simplified models for prediction of pro-environmental behavioral intentions. Forsyth, Garcia, Zyzniewski, Story, and Kerr (2004) used the two-factor awareness-appraisal model to assess resident willingness to protect and enhance the quality of the James River Watershed where they lived. In support of the awareness-appraisal model, the authors found that respondents who were aware of their watershed,

and considered it polluted, expressed the strongest pro-environmental behavioral intentions to participate in the cleanup process. Their study supports the model that a positive correlation exists between knowledge of environmental issues and pro-environmental behavior; moreover, knowledge paired with negative appraisal (or perception of personal risk due to a threatened watershed) is an even better predictor of pro-environmental behavioral intentions than awareness alone (Forsyth et al., 2004). However, this model does not take into account attitudinal variables, which many preceding researchers have found influential in producing pro-environmental behavioral intentions (Ramsey & Rickson, 1976; Hines et al., 1986; Hungerford & Volk, 1990; Diduck, 1999; Pooley & O'Connor, 2000).

In a later study, Story and Forsyth (2008) revisited the matter of watershed preservation in the James River Watershed. This time, they utilized the awareness-appraisal-responsibility (AAR) model to predict when individuals would be most likely to respond to environmental threats within their watershed. The authors (Story & Forsyth, 2008) concluded that "…awareness and a negative appraisal prompt residents to feel responsible for intervening" and "…responsibility is the proximate cause of engagement" (Story & Forsyth, 2008, p. 313). While the AAR model does not specifically address the multitude of variables working together in the Hines et al. (1986) Model of Responsible Environmental Behavior, it re-enforces the supposition that personality factors, such as sense of personal responsibility, influence behavioral intentions.

In summary, several EE researchers have developed conceptual models for predicting preferred outcomes, and many of these models share key variables; however, researchers have not reached a consensus in this arena. As Darner (2009) stated, "EE research has provided us with a collection of potentially useful predictors of pro-environmental behavior, but the field has yet to agree on an optimal set of predictors" (p. 41). Nevertheless, the literature reviewed for this study indicates that knowledge of environmental issues, personality factors (including attitudes, locus of control, and personal responsibility), and sense of threat are strong predictors of pro-environmental behavioral intentions (Ramsey & Rickson, 1976; Hines et al., 1986; Hungerford & Volk, 1990; Diduck, 1999; Pooley & O'Connor, 2000). These variables are important for predicting response patterns from individuals; they are also areas environmental educators can potentially influence.

Environmental Education through Audiovisual Media

Various media sources are used to transmit environmental information to the masses, including newspapers, magazines, radio, books, pamphlets, and television (Alaimo & Doran, 1981; Fortner, 1985; Ostman & Parker, 1986; Brothers, Fortner, & Mayer, 1991; Murphy, 1993; Barbas, Paraskevopoulos & Stamou, 2009). A number of studies have examined the influence of various media, including films (Appendix 3).

Fortner (1985) studied the relative effectiveness of both a formal teaching presentation in the classroom and a nature documentary on marine mammals (*Cousteau Odyssey*, "Mammals of the Deep: The Warm-Blooded Sea") among ninth grade students.

She found that comparable presentations in both the classroom lecture setting and the home viewing of the documentary successfully conveyed new information. Knowledge levels increased significantly following both classroom and film presentations, and remained considerably higher than pre-test levels even on the two-week delayed posttest (Fortner, 1985).

While gains in knowledge levels were similar in both treatment groups, attitude changes were only present in the television treatment group; students in this group demonstrated changes in attitudes towards the producer's attitude goals. According to Fortner (1985), visual film techniques including close-up shots, film cuts, and altering camera angles are inherently "instructional or affective elements" (p. 124). A teacher in a lecture setting may cover the same material; however, they do not have the capability, which is inherent in film, to express visual ideas (Fortner, 1985).

Holbert, Kwak, and Shah (2003) investigated the relationship between television use and pro-environmental behaviors. The objective of their study was to understand the roles that various forms of television programs play as mediators in the relationship between environmental concern and environmental behaviors (Holbert, Kwak, & Shah, 2003). The authors found that certain forms of fact-based television use, such as public affair programs and nature shows, was a strong predictor of pro-environmental behaviors among viewers. They also found that such television programming acts as a mediator between environmental attitudes and behaviors "to create a strong total positive effect of the former on the latter" (p. 190).

Holbert et al. (2003) posited that public affairs shows capitalize on affective approaches to sway their audience, wherein they use the 'fear factor' to raise awareness about risks associated with environmental problems. Nature documentaries, on the other hand, utilize a cognitive approach to raise awareness of the environment. Both nature documentaries and fact-based public affairs television shows "…contribute in unique positive ways to pro-environmental behaviors….as well as the attitudinal measure of environmental concern" (p. 189). They also found that pro-environmental attitudes are one of the strongest predictor of pro-environmental behaviors (Holbert et al., 2003). These conclusions support previous EE behavior research (Ramsey & Rickson, 1976; Hines et al., 1986; Hungerford & Volk, 1990; Diduck, 1999; Pooley & O'Connor, 2000).

Barbas et al. (2009) completed an exploratory study on student environmental sensitivity and nature documentaries about insects. The authors cited Hungerford and Volk's (1990) definition of environmental sensitivity as "an empathetic perspective towards the environment," and "one of the variables contributing to responsible environmental citizenship" (Hungerford & Volk, 1990, p. 11; Barbas et al., 2009, p. 14). Results from Barbas et al. (2009) showed that nature documentaries significantly influenced students' attitudes and beliefs about insects compared to students in the control group. While the documentaries improved student levels of environmental sensitivity, this trait manifested mainly as an emotional reaction rather than as knowledge and understanding (Barbas et al., 2009).

Film as a Source of Environmental Information for the Masses

Film not only has the power to influence viewer attitudes and knowledge levels, but is also has the potential to reach large audiences with varying backgrounds. According to a recent report from the Public Policy Institute of California, television is the top source for environmental information across age, education, and income groups (PPIC, 2007). In an earlier study, Ostman and Parker (1986) found that television was the most commonly used form of media, after newspapers. However, they also found that educated segments of the population relied less on television as a *believable* source of environmental information. The authors organized respondents into three classes based on their level of education; specifically, the classes represented individuals with 5-13, 14-16, and 17-21 years of education. They found a significant trend; while 15.5% of respondents with 5-13 years of education reported that television was the most believable source for environmental information, only 5.2% of respondents with 14-16 years of education and 2.9% of respondents with 17-21 years of education reported the same. The results show a decline of 12.6% from lowest to highest education level among respondents stating television as the most believable media source (Ostman & Parker, 1986).

However, the findings of Ostman & Parker's study (1986) relate specifically to broadcast journalism. When asked to assess the performance of newscasters, a large majority of respondents thought media personnel sensationalized and biased their reports, capitalized "…on only those stories…which would increase their audiences…and were not likely to give equal weight to all sides of an issue" (Ostman & Parker, 1986, p. 14).

As Ramsey & Rickson (1976) stated, "Education is often distinguished from propaganda on the grounds that the latter is one-sided" (p. 18). As long as mass media efforts "…de-emphasize knowledge bearing upon one side of an issue because of fear of promoting opposition," (Ramsey & Rickson, 1976, p. 18) this form of communication cannot be an effective educational tool.

Problem Statement

Extensive research in the field of EE has focused on the factors that yield pro-environmental responses from learners (Ramsey & Rickson, 1976; Hines et al., 1986; Hungerford & Volk, 1990; Diduck, 1999; Pooley & O'Connor, 2000). Researchers proposed various models to account for the interactions between key variables thought to influence pro-environmental responses (Ramsey & Rickson, 1976; Hines et al., 1986; Hungerford & Volk, 1990; Darner, 2009). Though consensus has not been reached on an optimum model, multiple studies indicate that a relationship exists among knowledge, personality factors (including attitudes, locus of control and personal responsibility), sense of threat, behavioral intentions, and actual behaviors. Specifically, the research indicates that the most influential personality factor in predicting individual responses towards environmental issues may be attitudes (Ramsey & Rickson, 1976; Hines et al., 1986; Pooley & O'Connor, 2000).

Other EE research examined how audiovisual media techniques can influence individuals' responses towards the environment. Fortner (1985) found that documentary films are an effective medium for changing learner knowledge levels and attitudes.

Holbert et al. (2003) reported a positive relationship between factual EE documentaries and pro-environmental behaviors. However, Ostman & Parker (1986) concluded that as viewer level of education increased, the believability of television (specifically broadcast journalism) as a source of environmental information decreased. The results of the latter study may be due to the biased and sensationalized nature of broadcast journalism and may not be directly comparable to factual and balanced EE documentary films.

EE literature also shows that issue-related instruction is especially effective in promoting pro-environmental behaviors (Hungerford & Volk, 1990). The water crisis in the Sacramento-San Joaquin Delta provides an excellent issue-oriented topic for testing factors that lead to pro-environmental behaviors. This topic requires knowledge, and an understanding of the urgency of the threat, for citizens to take action. A documentary film on this issue may be an important tool in this effort.

Objectives and Hypotheses

This study assessed the effectiveness of an educational documentary film, "California Kings: Sold Down the River," which covered the social, political, economic, and environmental aspects of California's Bay-Delta, in increasing viewer pro-environmental behavioral attitudes and intentions. According to the literature, individuals' knowledge levels, personality factors (attitude, locus of control, and sense of personal responsibility) and sense of personal threat are important variables that influence their pro-environmental behavioral intentions. The current study examined how this documentary film interacted with these variables to influence viewer responses towards

the Bay-Delta crisis. The objectives of this study were to investigate the impact of this documentary film on college students with different initial attitudes towards the environment and to determine how such films can promote pro-environmental behavioral intentions. This study tested two types of students: environmental studies (ENVS) and non-environmental studies (non-ENVS) majors.

This thesis addressed the overarching research questions: 1) How can educators design films that promote pro-environmental attitudes and intentions among viewers? 2) How can educators use the results of this study to improve future EE films? 3) Does a correlation exist between student majors and the treatment effect of the film?

To investigate these questions, this study examined the importance of factors including knowledge, worldview, perception of personal threat, and sense of personal responsibility in promoting pro-environmental attitudes and behavioral intentions using five hypotheses:

H_1: Student viewers of an educational documentary film on the social, political, economic, and environmental issues surrounding California's Delta will not show significantly higher levels of the following issue-specific measures after viewing the film than before viewing the film:

a) Knowledge levels,

b) Pro-environmental attitudes,

c) Pro-environmental behavioral intentions,

d) Perceived threat, and

e) Sense of personal responsibility.

H_2: With respect to the Delta ecosystem:

a) Perception of personal threat and sense of personal responsibility will not influence student behavioral intentions, both before and after viewing the film, and

b) Perception of personal threat and worldview will not influence student pro-environmental attitudes towards the Delta, both before and after viewing the film.

H_3: Due to the treatment effect of the film, and regardless of student major, there is no correlation between:

a) Changes in knowledge levels and changes in pro-environmental attitudes,

b) Changes knowledge levels and changes in behavioral intentions, and

c) Changes in pro-environmental attitudes and changes in behavioral intentions.

H_4: There is no significant difference between the scores of environmental studies (ENVS) and non-environmental studies (non-ENVS) students on the following measures, both before and after viewing the film:

a) Worldviews,

b) Issue-specific knowledge levels,

c) Pro-Delta attitudes, and

d) Pro-Delta behavioral intentions.

H_5: With respect to the Delta ecosystem, post-viewing attitudes, locus of control and sense of personal responsibility will not influence student pro-environmental behavioral intentions, regardless of student major.

Methods

Experimental Design

The author of this paper served as Associate Producer for this film and was involved in all aspects of research, interviews, and correspondence for subject content of production. The author was also involved in portions of videography, writing of voice-overs, and editing for the documentary film. The film consists of two segments with a total duration of approximately 44 minutes. The issue-focused documentary film, "California Kings: Sold Down the River," served as the treatment for experimental groups to test hypotheses relating to pro-environmental responses. Subject matter covered in the documentary film included the natural environment of California's Sacramento-San Joaquin Delta (the Delta) and human impacts including agricultural water uses, environmental water uses, and water politics. Pawlawski Sports, LLC produced this film, which will air on Outdoor Channel at a future date.

The film addressed several of the factors included in behavioral research models discussed earlier. The factors covered extensively in the film were knowledge,

perception of threat, and attitudes. The film briefly covered locus of control and personal responsibility.

Experimental groups completed group-administered surveys before and after viewing the film (see Appendix 4). Pre- and post-viewing surveys were identical with a few exceptions: 1) Pre-viewing surveys asked for demographic information, and 2) Post-viewing surveys asked respondents to assess the believability of the documentary film and 3) included four open-ended questions designed to gather feedback from students pertaining to Delta-specific knowledge, attitudes, and behavioral intentions. The surveys measured the short-term impacts of the film on knowledge levels, attitudes, behavioral intentions, personal responsibility, and sense of threat.

Survey Design and Data Collection

Based on a review of EE literature, the author developed the Model of Pro-Environmental Behavioral Intentions, shown in Figure 2, specifically for this study. The Model of Responsible Environmental Behavior (Hines et al., 1986) (Figure 1) provided the framework for this newer model. This model does not include the following variables from the Hines' model: action skills, knowledge of action strategies, and situational factors, because this study did not test these factors.

Research completed after Hines' analysis (1986) revealed that the following factors also influence behavioral intentions: perception of threat, worldview, and both the cognitive (beliefs) and affective (emotions) factors of attitudes. These factors were

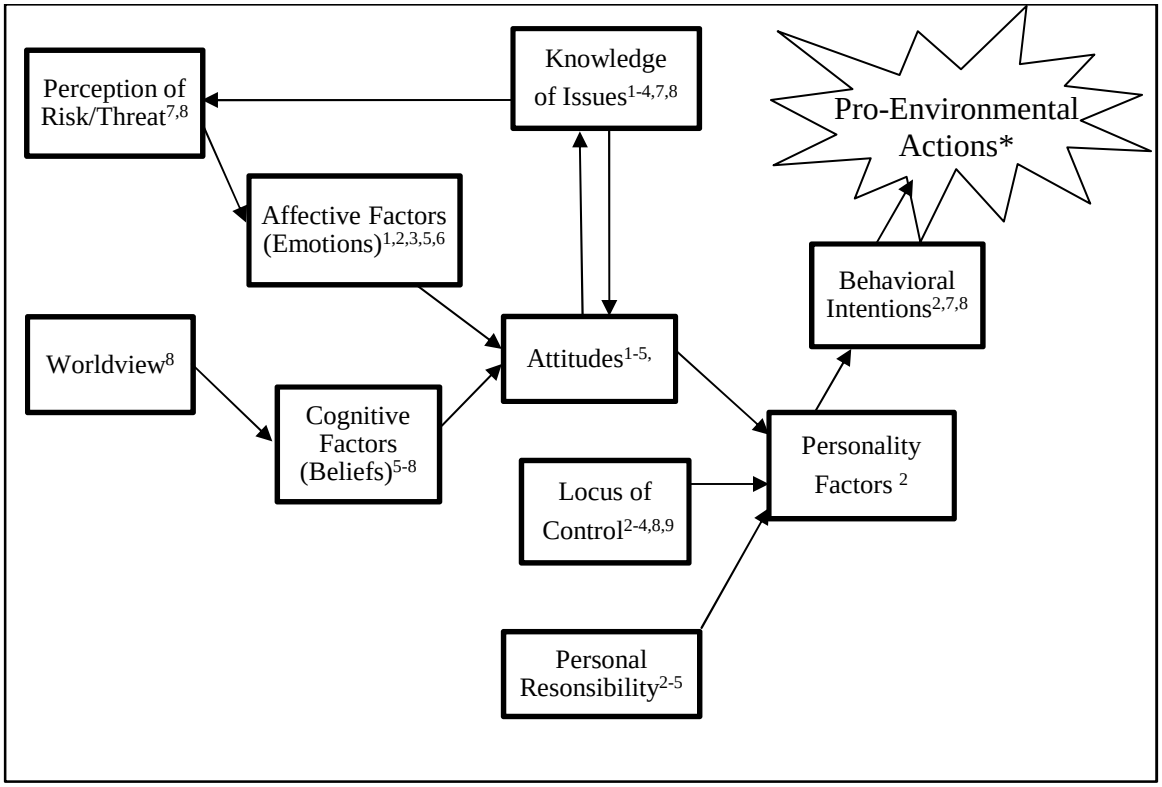

Figure 2: Model of Pro-Environmental Behavioral Intentions (Parker, 2012). [1]Ramsey & Rickson (1976). [2]Hines et al. (1986). [3]Hungerford & Volk (1990). [4]Diduck (1999). [5]Pooley & O'Connor (2000). [6]Holbert et al. (2003). [7]Forsyth et al. (2004). [8]Story & Forsyth (2008). [9]Darner (2009). *Pro-environmental actions were not measured in this study.

included in this new model. This study was not intended to challenge the validity of Hines' model; however, this study considered additional factors that may be of interest to EE film producers.

It is important to note that while Hines' et al. (1986) considered attitudinal variables in their study, they made no distinction between individuals' beliefs and emotions. Pooley and O'Conner (2000) found support for the theory that beliefs and feelings work together in a synergistic relationship to affect a person's attitude towards the environment; however, they found that these components might differentially

influence attitudes. According to the authors, "…the source of the information on which an attitude is based is important to further the development of this attitude or the development of related environmental attitudes" (Pooley & O'Conner, 2000, p. 719). The Model of Pro-Environmental Behavioral Intentions proposes that worldview (biospheric vs. anthropocentric) influences the cognitive component of attitudes. This model also proposes that sense of personal risk due to an environmental threat influences the affective component of attitudes.

Group-administered surveys for this experiment measured the variables included in the Model of Pro-Environmental Behavioral Intentions. Items with missing data were not included in the analysis. Surveys consisted primarily of close-ended questions. These questions are ideal for self-reporting measures because they are easy for respondents to answer and result in high response rates (Fowler, 1988). Closed-questions are by nature pre-coded, which facilitated data entry for statistical analysis (Fowler, 1988; Bourque & Clark, 1992). Close-ended questions were organized according to the items measured: knowledge levels (1-14), worldview (15-19), attitudes (20-25), behavioral intentions (26-30), personality factors (31-35), perception of threat (36-40), perceived believability of the film (41-43), and self-reported changes in opinions (44).

Single response multiple-choice and true/false questions measured respondent levels of knowledge specific to the issues addressed in the film. Participants were instructed to choose one answer for each question (Bourque & Clark, 1992).

Likert scale items gathered data on student personality factors (attitude, locus of control, and sense of personal responsibility), sense of threat, behavioral intentions, and

assessment of the film. The Likert scale is a summated scale, usually consisting of five-points, to which the respondent indicates their level of agreement or disagreement with a given statement (Miller, 1970; Alreck & Settle, 1995). Points on the scale represent: "strongly disagree" = 1, "disagree" = 2, "undecided' = 3, "agree" = 4, "strongly agree" = 5. The Likert scale is among the most commonly used scale for measuring attitudes and opinions (Bourque & Clark, 1992). Furthermore, this scale is highly reliable concerning understanding individuals' attitudes on complex topics (Miller, 1970; Alreck & Settle, 1995; Bourque & Clark, 1992).

General environmental attitudes, or worldview, were assessed using five measures from the revised New Environmental Paradigm (NEP) Scale (see Appendix 4) (Dunlap, Liere, Mertig, & Jones, 2000). The original NEP Scale was published in 1978 by Dunlap and Liere and "…has become the most widely used measure of environmental concern in the world…employed by hundreds of studies in dozens of nations" (Dunlap, 2008, p. 3).

For this study, scales measured environmental attitudes specific to the issues addressed in the film (see Appendix 4). Interviews from key stakeholders revealed reoccurring attitudinal positions; this scale reflected the most prominent themes.

Post-viewing surveys included four open-ended questions (see Appendix 4). These measures allowed students to answer questions in their own words and generated both expected and unexpected responses (Fowler, 1988). The first open-ended question addressed self-reported changes in viewer knowledge levels after watching the film. The second question dealt with the film's ability to encourage pro-environmental attitudes

among viewers. The third question focused on viewer recommendations for making the film more effective at influencing pro-environmental behavioral intentions. The final open-ended question asked viewers which film elements they felt were the most effective at increasing knowledge levels, attitudes, and behavioral intentions. The results of these open-ended measures helped answer the research questions posited above. Group-administered surveys included demographic questions at the beginning of the pre-viewing surveys. Information requested included gender, age, ethnicity, level of education, department or major and number of years living in California. Demographic factors can help identify certain segments of respondents that share certain attitudes or behave in similar ways (Alreck & Settle, 1995).

Prior to the experiment, the author used a pilot survey to assess whether certain questions were confusing and/or difficult to answer (Fowler, 1988). The survey instrument was emailed to approximately two dozen experts and stakeholders involved in the production of the film. Instructions sent along with the survey asked respondents to provide feedback on the readability, accuracy, and completeness of the survey. The author used this feedback to re-word several items for improved clarity.

Sample Population

The sample population for this study consisted of San José State University (SJSU) students enrolled in EnvS 001 (Introduction to Environmental Issues) and EnvS 010 (Life on a Changing Planet) classes during the Fall 2011 semester. These classes

fulfill core GE requirements and include both environmental studies (ENVS) majors and non-environmental (non-ENVS) studies majors.

A total of ten EnvS 01 and 010 class sections were offered during the Fall 2011 semester. Students in all sections were invited to participate in the study by their class instructors. Participation was voluntary; however, some students were offered extra credit by their class instructors if they chose to participate. Two student samples were surveyed on each of the following dates: October 20, 2011, November 4, 2011, and November 12, 2011. The average number of students for each of the six samples was approximately 20, with a total sample population of 121 students.

Data Analysis

Management and analysis of all data was conducted with SPSS for Windows. Repeated-measures t-test procedures tested H_1 (a-e). Multiple linear regression was used to test H_2 (a-b), and H_5. For H_2 (a), data collected on student perception of personal threat due to the health of the Delta ecosystem and student sense of personal responsibility were regressed on student behavioral intentions to determine the strength of this relationship. For H_2 (b), data gathered on student perception of personal threat due to the health of the Delta ecosystem and student worldview were regressed to see which of these independent variables accounted for the most variability in student attitudes towards the Delta ecosystem. For these hypotheses, data were analyzed from both pre- and post-viewing surveys. To test H_5, data collected from post-viewing surveys on student attitudes, locus of control, and sense of personal responsibility were regressed to see which one of these

dependent variables had the greatest influence on student pro-environmental behavioral intentions. The split file command was used to group students according to major (ENVS or non-ENVS). Correlational analyses tested H_3 (a-c) uncover potential relationships among changes from pre-viewing to post-viewing knowledge levels, attitudes, and behavioral intentions. The split file command was also used for this test. The Mann-Whitney *U* was used to test H_4 (a-d). This hypothesis dealt with potential variations between ENVS and non-ENVS students concerning worldview, issue-specific knowledge levels, pro-environmental attitudes, and behavioral intentions. To identify possible trends among the sample population, additional analyses were completed. Chi-square tests of independence were used to analyze open-ended questions from the demographic portion of pre-viewing surveys. A correlational analysis was completed on post-viewing data for knowledge levels, self-reported believability of the film and self-reported opinion changes due to the film. Lastly, responses to post-viewing open-ended questions were qualitatively analyzed.

Limitations

There are four major limitations of this study: 1) All factors tested were issue-specific to California's Delta, salmon, and water resources. Although an individual expresses pro-environmental behavioral intentions regarding these issues, there is no guarantee that they will respond to other environmental issues in a similar manner (Hungerford & Volk, 1990). 2) There is no guarantee that an individual will follow through with action simply because they express pro-environmental behavioral intentions. 3) The sample size for this experiment was relatively small (N = 121), and 4)

the sample was not representative of all college students, as all students surveyed were enrolled in EnvS classes. A similar study with randomly selected participants from the general public is needed to improve generalizability of EE film research.

Results

A total of 121 students, 94 non-ENVS and 27 ENVS, responded to the survey, however some students did not respond to every item on the survey. Table 1 presents participant demographics, which shows the following key results: 1) The majority of ENVS students were female (66.7%), while non-ENVS students consisted of roughly the same percentage of females (48.9%) and males (51.1%). 2) The majority of ENVS students (70.4%) considered themselves environmentalists, while a minority of non-ENVS students (25.5%) reported the same.

An alpha level of .05 was used for all statistical tests. A two-tailed *t* test was used to analyze the data on student issue-specific knowledge levels, pro-environmental attitudes, pro- environmental behavioral intentions, sense of personal responsibility, and perception of personal threat before and after viewing the film. Results showed that there was a significant increase in all of these variables among students after they viewed the film. On average, student knowledge scores from pre-viewing to post-viewing surveys increased by 1.19 points on a scale of 1-14 (SE= 0.16), $t = 7.53$, $df = 120$, $p < .001$, $d = 0.68$. Student pro-environmental attitude scores increased by 2.89 points on a scale of 1-30 ($SE = 0.27$) from pre-viewing to post-viewing surveys, $t = 10.62$, $df = 118$, $p < .001$, d =0 .97. The film also had a significant effect on student pro-environmental behavioral intentions towards the Delta. On average, student scores increased by 1.73

Table 1
Student Demographics

Major	Environmental Studies (ENVS) n = 27	Non-Environmental Studies (non-ENVS) n = 94
Female/Male	18 (66.7%) -Female 9 (33.3%) – Male	46 (48.9%) - Female 48 (51.1%) - Male
Age (years)	14 (51.9%)- 18-21 11 (40.7%) - 22-34 1 (3.7%) - 35-44 1 (3.7%) - 45+	77 (81.9%) - 18-21 15 (16.0%) - 22-34 2 (2.1%) - 35-44
Ethnicity	8 (29.6%) - Asian/Asian American 6 (22.2%) - Hispanic/Latino 13 (48.1%) - Non-Hispanic White	2 (2.1%) - American Indian/Alaska Native 37 (39.4%) - Asian/Asian American 15 (16%) - Hispanic/Latino 5 (5.3%) - Hawaiian/Other Pacific Islander 3 (3.2%) - Black/African American 31 (33%) - Non-Hispanic White 1 (1.1%) - Other
Years lived in California	2 (7.4%) - 0-5 9 (33.3%) - 11-20 12 (48.1%) - 21-30 3 (11.1%) - 31 +	5 (5.3%) - 0-5 6 (6.4%) - 6-10 60 (63.8%) -11-20 22 (23.4%) - 21-30 1 (1%) - 31 +
What kind of hobbies do you enjoy in your free time?	17 (63.0%) - Outdoor activities 10 (37.0%) - No Outdoor Activities	22 (24.2%) - Outdoor activities 69 (75.8%) - No Outdoor Activities
Do you consider yourself an environmentalist?	19 (70.4%) - Yes 4 (14.8%) - No 4 (14.8%) - Somewhat	24 (25.5%)- Yes 9 (52.1%) - No 20 (21.3%) - Somewhat

points on a scale of 1-25 (*SE* = 0.23) from pre-viewing to post-viewing surveys, t = 7.40, *df* = 120, *p* < .001, *d* = 0.67. Student scores on sense of personal responsibility towards the Delta ecosystem increased by an average of 0.48 points on a scale of 1-10 (*SE* = 0.13) from pre-viewing to post-viewing surveys, *t* = 3.68, *df* = 120, p < .001, *d* = 0.33. Lastly, student perception of personal threat due to the health of the Delta ecosystem increased by 2.06 points on a scale of 1-25 (*SE* = 0.28) from pre-viewing to post-viewing surveys, *t* = 7.28, *df* = 117, *p* < .001, *d* = 0.67 (Table 2).

Perception of personal threat and sense of personal responsibility accounted for just under half of the variance in pre-viewing behavioral intention scores (R^2 = .45), which was highly significant, *p* < .001. Perception of personal threat and sense of personal responsibility also accounted for just under half of the variance in post-viewing behavioral intention scores, R^2 = .46, *p* < .001 (Table 3).

With respect to student attitude scores, perception of personal threat and worldview accounted for just under 40% of the variance in pre-viewing attitude scores, R^2 = .38, *p* < .001. These two independent variables accounted for just under half of the variance in post-viewing attitude scores, R^2 = .46, *p* < .001 (Table 4).

The correlation between changes in issue-specific knowledge levels (*M* = 0.93, *SE* = 0.24, *n* = 27) and changes in pro-Delta attitudes (*M* = 2.74, *SE* = 0.48, *n* = 27,) among ENVS students from pre-viewing to post-viewing surveys was not significant, *p* = .643 The correlation between changes in issue-specific knowledge levels (*M* = 1.27, *SE* = 0.19, *n* = 94) and changes in pro-Delta attitudes (*M* = 2.94, *SE* = 0.32, *n* = 92) among

Table 2
Results From Repeated-Measures t Tests for ENVS and Non-ENVS Students

Variable	*M* Score Before	*M* Score After	*M* Change in Score	*t*	*df*
Issue-Specific Knowledge Levels	11.28	12.47	1.19	7.53*	120
Pro-Delta Attitudes	21.52	24.41	2.89	10.62*	118
Pro-Delta Behavioral Intentions	17.64	19.36	1.73	7.40*	120
Sense of Personal Responsibility for the Delta	6.45	6.93	0.48	3.68*	120
Perception of Threat due to the Delta's Ecosystem	19.77	21.83	2.06	7.28*	117

Note. * $p < .001$.

Table 3
Predictors of Pro-Delta Behavioral Intentions on Pre- and Post-Viewing Surveys

Variable	*B*	*SE*† *B*	β
Constant[a]	7.18**	1.17	
Pre-viewing sense of threat	0.23**	0.06	0.27**
Pre-viewing personal responsibility	0.92**	0.15	0.47**
R^2	0.45		
F	46.43**		
Constant[b]	2.85	1.89	
Post-viewing sense of threat	0.53**	0.10	0.42**
Post-viewing personal responsibility	0.73**	0.15	0.38**
R^2	0.46		
F	49.03**		

Note. [a]$n = 117$. [b]$n = 119$. †*SE* = Standard error of *B*.
* $p < .01$. ** $p < .001$.

Table 4
Predictors of Pro-Delta Attitudes on Pre- and Post-Viewing Surveys

Variable	*B*	*SE*[†] *B*	β
Constant[a]	10.34**	1.36	
Pre-viewing worldview (biospheric vs. anthropocentric)	0.27**	0.07	0.36**
Pre-viewing sense of threat	0.28**	0.07	0.35**
R^2	0.389		
F	35.10**		
Constant[b]	5.88*	1.92	
Post-viewing worldview (biospheric vs. anthropocentric)	0.29**	0.08	0.31**
Post-viewing sense of threat	0.58**	0.11	0.46**
R^2	0.46		
F	50.10**		

Note. [a]*n* = 118. [b]*n* = 120. [†]*SE* = Standard error of *B*.
* $p < .01$. ** $p < .001$.

non-ENVS students from pre-viewing to post-viewing surveys was not significant, $p = .986$.

The correlation between changes in issue-specific knowledge levels ($M = 0.93$, $SE = 0.24$, $n = 27$) and changes in pro-Delta behavioral intentions ($M = 1.37$, $SE = 0.43$, $n = 27$,) among ENVS students from pre-viewing to post-viewing surveys was not significant, $p = .720$. The correlation between changes in issue-specific knowledge levels ($M = 1.27$, $SE = 0.19$, $n = 94$) and changes in pro-Delta behavioral intentions ($M = 1.88$, $SE = 0.28$, $n = 92$) among non-ENVS students from pre-viewing to post-viewing surveys was not significant, $p = .719$.

The correlation between changes in pro-Delta attitudes ($M = 2.74$, $SE = 0.48$, $n = 27$) and changes in pro-Delta behavioral intentions ($M = 1.37$, $SE = 0.43$, $n = 27$,) among

ENVS students from pre-viewing to post-viewing surveys was not significant, $p = .223$. The correlation between changes in pro-Delta attitudes ($M = 2.93$, $SE = 0.33$, $n = 92$) and changes in pro-Delta behavioral intentions ($M = 1.88$, $SE = 0.28$, $n = 92$) among non-ENVS students from pre-viewing to post-viewing surveys was highly significant, $p < .001$ (Figure 3).

The results of Mann-Whitney *U* tests comparing ENVS to non-ENVS students were significant for pre-viewing ($z = -2.76$, $p = .005$) and post-viewing ($z = -3.51$, $p < .001$) worldviews. ENVS students had an average pre-viewing rank of 77.37 and a post-viewing rank of 81.6, while non-ENVS students had an average pre-viewing rank of 56.30 and a post-viewing rank of 55.04. For post-viewing worldview scores, ENVS students had an average rank of 81.76, while non-ENVS students had an average rank of 55.04.

The results of Mann-Whitney *U* tests comparing ENVS to non-ENVS student knowledge levels were significant for pre-viewing ($z = -2.24$, $p = .02$) but were not significant for post-viewing ($z = -1.72$, $p = .09$) scores. ENVS students had an average pre-viewing rank of 74.04 and a post-viewing rank of 70.83, while non-ENVS students had an average pre-viewing rank of 57.26 and a post-viewing rank of 58.18.

The results of Mann-Whitney *U* tests comparing ENVS to non-ENVS student issue-specific pro-environmental attitudes were significant for pre-viewing ($z = -3.98$, $p < .001$) and post-viewing ($z = -3.38$, $p = .001$) surveys. ENVS students had an average pre-viewing rank of 83.85 and a post-viewing rank of 80.30, while non-ENVS students had an average pre-viewing rank of 53.72 and a post-viewing rank of 54.75.

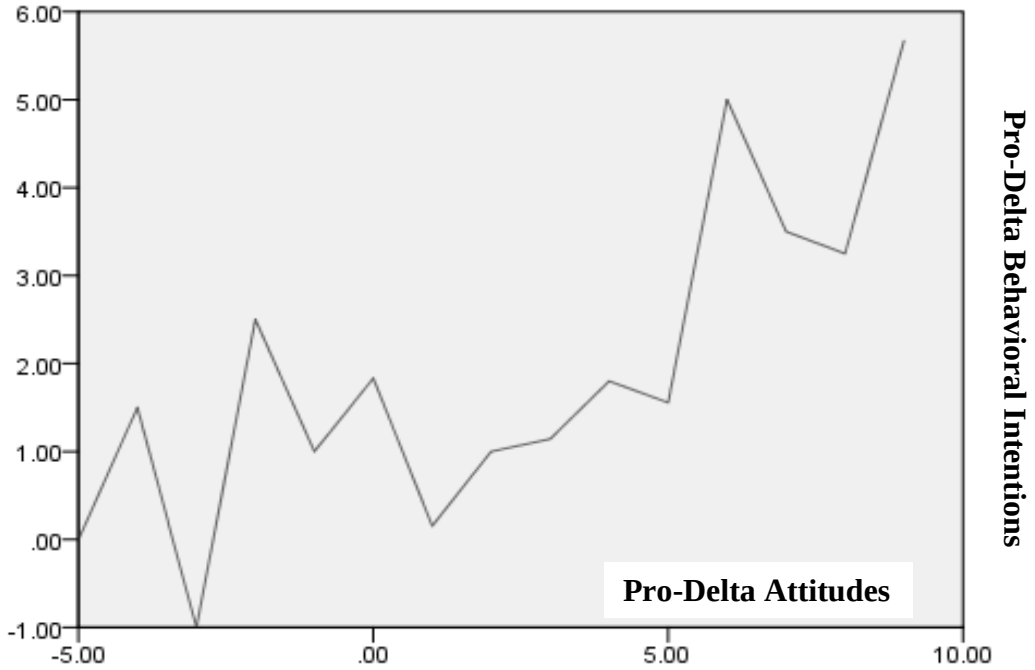

Figure 3: Correlation Between Changes in Pro-Delta Attitudes and Pro-Delta Behavioral Intentions Among Non-ENVS Students

The results of Mann-Whitney *U*-tests comparing ENVS to non-ENVS student issue-specific pro-environmental behavioral intentions were significant for pre-viewing ($z = -3.63$, $p < .001$) and post-viewing ($z = -2.82$, $p = .004$) surveys. ENVS students had an average pre-viewing rank of 82.50 and a post-viewing rank of 77.67, while non-ENVS students had an average pre-viewing rank of 54.82 and a post-viewing rank of 56.21 (Table 5).

Student post-viewing behavioral intentions were regressed on attitudes, locus of control, and personal responsibility. The split file command separated the data according to student types (ENVS and non-ENVS students) (Table 6).

Table 5
Comparing Mean Ranks for ENVS and Non-ENVS Students on Worldview, Issue-Specific Knowledge Levels, and Pro-Delta Attitudes and Behavioral Intentions

Factor	ENVS Mean Rank		Non-ENVS Mean Rank		*z*
Pre-viewing	*n*		*n*		
Worldview	27	77.37	94	56.30	-2.76**
Issue-Specific Knowledge Levels	27	74.04	94	57.26	-2.24*
Pro-Delta Attitudes	27	83.85	93	53.72	-3.98***
Pro-Delta Behavioral Intentions	27	82.50	94	54.82	-3.63***
Post-viewing	*n*		*n*		
Worldview	27	81.6	94	55.04	-3.51***
Issue-Specific Knowledge Levels	27	70.83	94	58.18	-1.72
Pro-Delta Attitudes	27	8.30	93	54.75	-3.38**
Pro-Delta Behavioral Intentions	27	77.67	94	56.21	-2.82**

Note. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 6
Predictors of Pro-Delta Behavioral Intentions on Post-Viewing Surveys for ENVS and. Non-ENVS Students

Variable	*B*		*SE*† *B*		β	
	ENVS[a]	Non-ENVS[b]	ENVS	Non-ENVS	ENVS	Non-ENVS
Constant	5.27	3.95	4.18	2.01		
Pro- Delta attitudes	0.01	0.38**	0.20	0.09	0.01	0.39**
Personal responsibility	0.59	0.62*	0.29	0.20	0.32	0.32*
Locus of control	0.91*	0.16	0.27	0.12	0.56**	0.14
R^2	0.56*	0.43*				
F	9.60*	23.23*				

Note. [a]$n = 26$. [b]$n = 92$. †*SE* = Standard error of *B*
* $p < .01$. ** $p < .001$.

For ENVS students (n = 26), these three predictors accounted for over half of the variance in behavioral intention scores (R^2 = .56), which was highly significant, $p < .001$. Attitudes (p =.98) and personal responsibility (p = .06) did not demonstrate significant effects on behavioral intentions. Locus of control was the only independent variable that demonstrated significant effects on behavioral intentions among ENVS students, p = .003.

For non-ENVS students (n = 92), attitudes, locus of control, and personal responsibility accounted for just under half of the variance in behavioral intention scores (R^2 = .44), which was highly significant, p <.001. Attitudes ($p < .001$) and personal responsibility (p = .003) demonstrated significant effects on behavioral intentions among non-ENVS students. Locus of control was the only independent variable that did not demonstrate significant effects on behavioral intentions for non-ENVS students, p = .164.

Pre-viewing surveys asked students to state their major (ENVS vs. non-ENVS) and whether or not they considered themselves environmentalists. Results from a chi-square test of independence indicated that there was a significant relationship between these two variables, $\chi^2(2, n = 120) = 18.86$, $p < .001$. While 70.4% of ENVS students considered themselves environmentalists, only 25.8% on non-ENVS students reported the same (Table 1).

Pre-viewing surveys also asked students to list the hobbies they enjoyed in their free time. Responses were coded so that individuals who listed at least one outdoor hobbies (such as hiking, biking, trail running, fishing, mountain climbing, etc…) were

given the value of "0" while individuals who listed only indoor activities (such as reading, drawing, video games, watching movies, etc…) were given the value of "1." A chi-square test of independence indicated that partaking in outdoor hobbies was more common among ENVS students than non-ENVS students, $\chi^2(1, n = 118) = 14.16, p < .001$. While 63.0% of ENVS students enjoy outdoor hobbies, only 24.2% on non-ENVS students indicated the same (Table 1).

Post-viewing survey questions gathered data on whether or not students felt the film was believable, factual, and credible. Students also indicated if their opinions regarding the Delta and salmon changed after viewing the film. The correlation of self-reported believability of the film ($M = 11.58$, $SE = 0.19$, $n = 120$) and post-viewing opinion changes due to the film ($M = 3.66$, $SE = 0.09$, $n = 120$) was highly significant, $r(118) = 0.31$, $p = .001$.

Post-viewing surveys included four open-ended questions. A qualitative analysis of responses to these items revealed common themes. The most prevalent themes for the first open-ended question included California's: king salmon fishery, water management and distribution, Sacramento-San Joaquin Delta, agricultural sector, and the economic implications of the Delta's decline. The most common responses for the second open-ended question included attitudinal shifts towards increased sensitivity for the Delta ecosystem, sustainable water management, a desire to understand all sides of the issue, and increased concern over California's king salmon. For the third open-ended question, the most common response was "yes" (64 responses), indicating that the film encouraged those students to take pro-environmental action regarding the Delta, and/or salmon. Only

26 students answered “no” for this question. The final open-ended question revealed that the statistics on the Delta’s decline, the economic implication of this decline, hearing both sides of the story, expert opinions, and visuals were the most powerful film elements. The Tables 7-10 summarize the results from post-viewing surveys among both ENVS and non-ENVS students.

Discussion

Results of this study indicate that the documentary, “California Kings: Sold Down the River,” significantly increased issue-specific knowledge levels, pro-environmental attitudes, and pro-environmental behavioral intentions among ENVS and non-ENVS SJSU students. These outcomes are consistent with previous EE behavior research. Hungerford and Volk (1990) concluded that issue-specific instruction is successful in promoting pro-environmental responses from learners. Before a person can express pro-environmental attitudes or behavioral intentions towards an issue, they must first understand the environmental problem (Hungerford & Volk, 1990).

While knowledge of environmental issues is a prerequisite for promote pro-environmental responses from learners, knowledge alone does not guarantee such outcomes. Other factors also influence the relationship between knowledge levels and pro-environmental behavioral intentions (Ramsey & Rickson, 1976; Hines et al., 1986; Hungerford & Volk, 1990; Pooley & O’Conner, 2000; Forsyth & Story, 2004).

Results of this study showed no correlation between changes in student knowledge levels and changes in student pro-Delta attitudes, regardless of student major. These findings may be partially explained by research results from Barbas et al. (2009).

Table 7 *Common Themes Students Learned From the Delta Documentary*	
"Did this documentary film teach you anything new about the issues addressed? If so, please list up to three issues you learned about while viewing this film."	Number of Responses
California king salmon	(65 total)
• Population in decline/facing extinction	45
• Effects of pumping on salmon	8
• Effects of dams on salmon	7
• General knowledge about salmon	5
California's water management/distribution	(65 total)
• Abuse of water	22
• Water exports from Delta/pumping uphill	17
• Water scarcity/human implications	14
• Water politics	4
• Lack of voice for the voter	4
• Role of government	3
• Peripheral Canal	1
Sacramento-San Joaquin Delta	(43 total)
• Exploitation of Delta/state of crisis	24
• General knowledge about Delta	9
• Other Delta species facing extinction	7
• Wastewater dumping/pollution problems	3
California's agricultural sector	(40 total)
• Subsidized water for corporate farms	23
• Agricultural water needs	8
• Salted soil from irrigation water/selenium	6
• General knowledge about agriculture	3
Economic Implications	(37 total)
• Salmon fishing jobs lost	14
• General economic implications of water	10
• Feud between farmers and fishermen	7
• Farming jobs lost	3
• Not everyone will win/someone will lose	3
Water Conservation	(5 total)
• Orange County as a good example	3
• Importance of conservation	2
Miscellaneous	
• No answer	36
• Reinforced existing knowledge	5
• Most information was new	3

Table 8 *Common Attitudinal Shifts Due to the Delta Documentary*	
"Did this film influence your attitudes regarding the Delta ecosystem?"	Number of Responses
Sacramento-San Joaquin Delta • We need to protect/help the Delta ecosystem • The Delta is in a state of serious decline • People are exploiting the Delta • The Delta is important for California's economy	(50 total) 34 9 5 2
Water Supply • We need to stop taking so much water from the Delta • We need to learn to use water more efficiently • Concern over water scarcity	(29 total) 13 12 4
Awareness • Desire to hear both sides/understand all of the issues • Desire for compromise/to find a balance/to co-exist	(29 total) 24 5
California king salmon • Concerned about this species extinction	(15 total) 15
Agriculture • Against subsidized water for corporate farms • Against misrepresentation of farm unemployment	(6 total) 5 1
Miscellaneous • No influence on attitudes • Reinforced current attitudes • No answer	(42 total) 11 10 21

Table 9 *Common Changes in Behavioral Intentions Due to the Delta Documentary*	
"Did this film encourage you to take action to protect California's Delta and/or salmon population?"	Number of Responses
Yes • Desire to find ways to help fix the damaged Delta • Will vote to protect Delta/salmon • Will tell others about information on film • Will conserve water • Will donate money	(64 total) 43 16 2 2 1
No • Do not know how to help/not enough information • Do not believe one person can make a difference • Do not feel strongly enough about any issue • Care more about farming than the Delta	(26 total) 11 6 5 4
Miscellaneous • No answer	 31

Table 10 *Most Effective Film Elements from the Delta Documentary for Influencing Student Responses*	
"Which elements of this film did you find the most powerful at influencing you knowledge, attitudes, or intentions to act on the issues addressed?"	Number of Responses
Statistics • Facts about declining numbers of fish/effects on fish • Facts about how much water is being taken from the Delta • Historical changes in the Delta/consequences of dams • Facts about water scarcity	(40 total) 27 8 4 1
Economic implications • Job losses in fishing industry • Importance of salmon to economy • Drive of fishermen to keep fishing	(21 total) 15 4 2
Hearing both sides • Interviews from farmers and fishermen/not overly biased	(17 total) 17
Expert opinions • Interviews from scientists/professors • Logically made sense	(16 total) 14 2
Visuals • Images of dead fish/fish in buckets • Graphs and charts • Documents/newspaper clippings	(13 total) 9 3 1
Agriculture • Facts about subsidized water • Misrepresentation of farm unemployment	(12 total) 10 2
Miscellaneous • No answer	31

Their study revealed that nature documentaries can significantly influence pro-environmental attitudes, which in turn influence environmental sensitivity. Furthermore, their study demonstrated that the emotional component of attitudes was more influential than knowledge levels in increasing environmental sensitivity. However, prior EE research revealed that knowledge levels and attitudes interact in a positive feedback loop; increased knowledge of environmental issues promotes pro-environmental attitudes towards those issues (Ramsey & Rickson, 1976; Alaimo & Doran, 1981; Fortner & Lyon,

1985). In 1985, Fortner and Lyon found that viewers who gained the most knowledge from a documentary film also tended to express the strongest pro-environmental attitude changes towards the issues addressed in the film. According to previous research, documentary films covering specific environmental issues should increase knowledge levels and subsequently promote pro-environmental responses from viewers. The disjunction between the findings from this research and previous research may be because the survey questions measuring student knowledge levels were not challenging enough. Results from pre-viewing surveys showed that most students were relatively knowledgeable concerning the items measuring knowledge levels. A correlation between changes in knowledge levels and changes in attitudes may have been found if the questions measuring student knowledge levels addressed information about the Delta that was less well known.

Results of this study showed a correlation existed between changes in student pro-Delta attitudes and changes in student pro-Delta behavioral intentions. Prior EE research, which suggests that pro-environmental attitudes are an important determinant of pro-environmental behavioral intentions (Ramsey & Rickson; Hines et al., 1986; Pooley & O'Conner, 2000; Holbert et al., 2003), supports the conclusions from this thesis.

Responses to open-ended questions show that attitudinal shifts towards the producer's goal of increased sensitivity for the Delta ecosystem and California king salmon, as well as the overall effectiveness of the film, increased because stakeholders on all sides of the issue were given a voice. These results indicate that educators should teach multiple sides of environmental issues rather than only the viewpoint they wish to

promote. Contrary to this result, Ramsey & Rickson (1976) found that knowledge of more than one side of an issue might lead to moderate attitudes among learners, but educators should nevertheless clarify divergent opinions (Ostman & Parker, 1986; Diduck, 1999). According to Ostman and Parker (1986), respondents found one-sided television programs unreliable and considered them propaganda; the researchers concluded that educators should emphasize knowledge concerning all sides of the issue. Diduck (1999) found that educators should explain opposing viewpoints so that learners can identify, for themselves, misleading or fraudulent arguments.

The film used in this experiment included interviews from multiple stakeholders with opposing viewpoints regarding California's Bay-Delta. The film promoted information on the environmental, social, political, and economic issues facing California's Delta and water resources. Perhaps as a result on the film's inclusion of multiple viewpoints, students expressed stronger pro-environmental attitudes and behavioral intentions regarding these issues on post-viewing surveys compared to pre-viewing surveys.

Both ENVS and non- ENVS student levels of perceived personal threat and sense of personal responsibility concerning the Delta ecosystem increased after viewing this documentary film. According to the Model of Pro-Environmental Behavioral Intentions (Parker, 2012), perception of threat influences the affective component of a learner's attitude. Attitudes and sense of personal responsibility are personality factors that can influence behavioral intentions. Forsyth et al. (2004) found that awareness paired with perception of threat is a better predictor of pro-environmental behavioral intentions than

awareness alone. In this study, we did not directly analyze the relationship between awareness, perception of threat, and behavioral intentions. However, results of the current study show that a sense of threat influenced pro-Delta attitudes and that changes in pro-Delta attitudes correlated to changes in pro-Delta behavioral intentions.

Story and Forsyth (2008) discovered that perception of threat paired with sense of personal responsibility is yet a better predictor for pro-environmental behavioral intentions among learners. The findings from this study support the supposition that perception of threat and sense of personal responsibility correlate with behavioral intentions. Results show that sense of personal responsibility explained a greater portion of variance in behavioral intentions compared to sense of threat on pre-viewing surveys; however, this relationship switched on post-viewing surveys, as sense of threat became the more influential factor. A possible explanation for this shift may be because the film spent considerable time outlining the gravity of threats facing Californians due to the health of the Delta ecosystem, while the film spent very little time addressing personal responsibility.

On pre-viewing surveys, student perception of threat and worldview had similar bearings on pro-environmental attitudes. However, on post-viewing surveys, perception of threat accounted for greater variance in attitudes than did worldview. These findings suggest that when student perception of threat increases, so does this variable's influence on student issue-specific environmental attitudes. Furthermore, as perception of threat increases, the relative influence of worldview on student attitudes decreases.

ENVS student scores were compared with non-ENVS student scores on pre- and post-viewing surveys to investigate significant differences in worldviews, knowledge levels, attitudes, and behavioral intentions. Non-ENVS students represent the type of population environmental education documentaries need to target. Results indicate that there was no systematic difference between ENVS and non-ENVS student post-viewing knowledge levels; however, all other scores tended to be higher among ENVS students compared to non-ENVS students. These findings suggest that regardless of major, students tended to gain the same amount of knowledge regarding the Delta. Since pro-environmental attitudes and behavioral intentions tended to be higher among ENVS students on post-viewing surveys, this study supports the theory that other variables have a greater influence on pro-environmental responses than increased knowledge levels (Ramsey & Rickson, 1976; Hines et al., 1986; Hungerford & Volk, 1990).

The effects of personality factors (attitudes, locus of control and sense of personal responsibility) on student post-viewing behavioral intentions revealed that certain factors influenced ENVS and non-ENVS students in different ways. Locus of control was the only personality factor that demonstrated a significant effect on post-viewing behavioral intentions among ENVS students. A possible explanation for this finding is that ENVS students generally possess an internal locus of control, which leads them to believe that their efforts can make a difference (Hungerford & Volk, 1990). Since they feel empowered to make a difference, they purposely acquire more knowledge on the matter they wish to influence (Diduck, 1999). For this reason, individuals with an internal locus

of control who are interested in helping the environment are more likely to enroll in an Environmental Studies program than students who do not possess this personality factor.

Locus of control was the only personality factor that did not show significant effects on behavioral intentions among non-ENVS students. Attitudes and sense of personal responsibility were significant factors for non-ENVS students. Attitudes among non-ENVS students demonstrated a stronger effect on post-viewing behavioral intentions than did sense of personal responsibility. Since the overarching goal of EE is to promote pro-environmental responses from learners (Hungerford & Volk, 1990), and attitudes are one of the most important determinants behavior (Pooley & O'Conner), these findings suggest that educators should target attitudes when educating the general public.

Open-ended questions were included on post-viewing surveys to gather additional feedback on student responses to the film (see Tables 10-13). When asked what issues they learned about while viewing the film, the most common responses among students were:

1) California's king salmon population is declining in numbers (45 responses),

2) California's Delta is in a state of ecological crisis (24 responses),

3) Corporate farms receive subsidized water (23 responses), and

4) California's water resources are being abused (22 responses).

These responses were anticipated, since the goal of this film was to educate individuals on these exact issues. One response summated the key issues addressed in the film:

> I learned that the decline of salmon was caused by how much we have abused the natural source of water. I learned that our generation is paying the consequences

of the dams built decades ago. In addition, I learned that unemployment has risen because of our over-use of water in the Delta (Pawlawski, 2011).

Other anticipated responses included, “I have learned that water supply is worth more than gold,” “I learned that our water situation is worse than I thought and that virtually everything humanity does screws up nature in some way,” and “some farmers abuse the system by selling water for their own profit” (Pawlawski, 2011).

The second open-ended question asked students about how the film influenced their attitudes regarding the Delta ecosystem. For students who reported attitude shifts due to the film, the most common themes among responses were:

1) I believe that the Delta ecosystem needs help/protection (34 responses),

2) I am more aware of all sides of the issue (24 responses),

3) I am more concerned about California’s king salmon (15 responses), and

4) I believe that less water should be taken from the Delta (13 responses).

It is interesting to note that two of the most common attitude changes reported among viewers strongly coincide with the most common responses concerning new knowledge acquired from viewing the film. Forty-five students (37.2%) learned that California’s king salmon population was declining in numbers; 15 students (12.3%) developed a sense of concern over this species. In addition, 34 students (28.1%) learned that the Delta is in a state of ecological crisis and 50 students (41.3%) reported that the Delta ecosystem needs protection.

Several responses to this open-ended question indicated the film fostered awareness and influenced attitudes concerning the Delta ecosystem and salmon

population. One student responded, “I did not know how valuable the Delta ecosystem was before, in terms of biodiversity. I want to protect it more after viewing the film.” Another student stated, “I don’t want my actions or my negligence to be the reason for another species’ extinction.” In support of the theory that multiple viewpoints should be given so that viewers can decipher the truth for themselves, one student responded, “The fact that the farming interests misrepresented the cause of farm unemployment and the fact that they are allowed to sell subsidized water for profit is unacceptable to me.”

Although the majority of student responses showed that the film influenced their attitudes, several students indicated that the film had no influence on their attitudes. Five students (4.1%) reported that they still could not choose a side. Responses included, “I still do not really have an opinion on this issue,” “I am still neutral regarding many issues,” and “My attitude did not change, because I feel my attitude won’t change anything that is already present and going on.” A detailed answer from one student provided a possible explanation:

> Mostly, my attitudes [regarding the Delta ecosystem] did not change. I agree something needs to be figured out as to what is going wrong… I do not really have an opinion on the proper solution right now because I do not see that the right one would be, before or after the video.

While the film clearly outlined the problems facing the Delta, it provided no definitive solution for solving those problems. The film suggested several possible solutions, such as water conservation by both the urban and agricultural sectors, taking less water from the Delta, and developing diversified water portfolios with local supplies

(such as Orange County's groundwater replenishment plant). However, the producers could not specify a single correct solution, because no single solution exists. The results of this thesis, specifically self-reported pro-Delta behavioral intentions, may have demonstrated a greater pro-environmental shift if specific action strategies were included at the end of the film.

The most common response among students when asked if the film encouraged them to take action to protect California's Delta and/or salmon population was "yes" with 64 responses (52.9%). Of those affirmative responses, 43 students responded that they desired to find ways to help fix the Delta. Another 16 students stated that they would support legislation intended to protect the Delta and/or salmon. The remaining students claimed they would tell others about the film (2 responses), conserve water (2 responses), or donate money (1 response) to help the Delta and/or salmon.

Of 121 students surveyed, 26 students (21.5%) responded that the film did not encourage them to take action. Among these students, the most common reason provided for not taking action was that they did not know how to help or they did not have enough information (11 responses). Student responses included, "[The film] would have been more effective if it had listed ways to help at the end," "[The film] just told me facts about the Delta. If it would have told me an easy way to get involved, maybe I would help," and "I don't have enough information on what the best solution to this problem is, but I guess no one does or can agree." Undoubtedly, the film could have been more effective if it outlined clear ways for viewers to become involved in these issues.

Six students (5.0%) stated that they did not believe a single person could make a difference. One student answered:

> I care about the issues, but I still do not feel that I could make much of a difference. In America, the only thing that influences Congress is money. Corporate America will always win. They are the one percent that virtually controls every dollar we have.

Other answers included, “One person, me, won’t make any difference,” “I feel my actions alone won’t do much,” and “I don’t think there is very much I can do personally.”

These students likely possess an external locus of control--they believe they are powerless to make a difference. While educators may be unable to have a direct influence on student locus of control over the course of one encounter, educators can promote responsible behaviors. As Diduck (1999) pointed out, locus of control is a personality factor that can change over time as students engage in responsible behaviors. If this film had clearly stated ways in which students could help the Delta and salmon, perhaps those students with an external locus of control would have felt more empowered to become “agents of change” (Diduck, 1999).

The remaining students in this group reported that they did not feel strongly enough about any issue (5 responses) or they cared more about farming than the Delta (4 responses). Thirty-one students (25.6%) left this question unanswered.

The final open-ended question asked students to identify which elements of the film they found most powerful at influencing their knowledge levels, attitudes, or behavioral intentions concerning the issues addressed in the film. The most common

answer (27 responses and 22.3%) given among students was the statistics/facts about the declining numbers of fish in the Delta. One student wrote, “When I saw the decline in the salmon and bass populations, the numbers were just staggering.” Responses from 15 students (12.4%) cited that the economic implications of job losses in the fishing industry were the most influential element in shaping their responses to the film. “I was shocked to hear fishermen quit their 9-5 jobs so that they could fish, but because the water conditions are harsh, they are not allowed to fish, causing them to have no jobs,” and “I never realized how much salmon fishing helped our economy,” were among student responses. A good portion of students stated that the interviews influenced their knowledge levels, attitudes, and/or behavioral intentions regarding the Delta ecosystem. Seventeen students (14.0%) indicated that the inclusion of interviews from both the farmers and the fishermen was powerful because the film was not overly biased. One student wrote, “I liked that both sides were shown.” Another student responded, “I thought that providing all of the different opinions was very powerful in itself. We saw the farmers’ point of view, the salmon’s point of view, and also the government’s point of view.” Another 14 students (11.6%) responded that the expert interviews from scientists and professors were the most powerful elements of the film. Student responses included, “The ecologists and experts always influence me,” “The expert testimonies was the best [film element],” and “When the scientists from U. C. Davis spoke.”

Thirteen students (10.7%) stated that the visual elements were powerful at influencing their responses. Responses included, “The graphs and charts painted the most shocking picture,” “I think that when they showed actual documents, that caught my

attention, like the one about selling water," and "The dead salmon on the shores was really heartfelt for me as well."

The results of this study are specific to SJSU students, enrolled in ENVS 01 and 10 classes, who viewed this documentary film on the Delta. However, the lessons learned from this study may help future educators design effective documentary films on other environmental issues.

Lessons Learned

The first lesson learned is that, whenever possible, rather than suggesting abstract solutions for an environmental problem, EE film producers should specify a tangible solution. A single solution for the problems of the Delta does not exist, but there are actions people can take. In the absence of a straightforward course of action, some viewers remained indifferent to the issue. EE films should also dictate detailed action strategies so learners feel empowered to engage in responsible behaviors to solve environmental problems.

The second lesson learned is that EE films should include differing viewpoints and opinions from multiple stakeholders, rather than only the one perspective they wish to promote. Research (Hungerford & Volk, 1999; Diduck, 1999) has shown that students benefit from hearing both sides, since conflict leads to critical assessment of environmental problems (Diduck, 1999). Student responses from this study clearly support this theory. While opposing viewpoints influenced a handful of students, the majority of students responded in favorable ways to this film's design. Future EE films, including both sides of the argument, may consider "book-ending" controversial

interview pieces with interviews promoting information that could support pro-environmental behavior. Viewers may only retain the point made in the closing argument.

A third lesson learned is that in order to increase pro-environmental behavioral intentions among viewers, EE films must promote pro-environmental attitudes. This finding is especially important for viewers who are less familiar with environmental issues, such as the non-ENVS students who participated in this study, or the general public.

Furthermore, EE films should consider both the cognitive and affective components of viewer attitudes. Worldview can influence a person's beliefs (the cognitive components of attitudes); however, it is unlikely that a person's worldview will change through a single EE attempt. Lifetime experiences and long-term exposure to environmental factors shape a person's worldview more than a single viewing of an EE film. However, if EE films include specific action strategies that empower learners to become involved, perhaps learner experiences and active participation in responsible environmental behaviors can shift their worldview closer to a biospheric approach.

Results also suggest that students who find EE films most believable are likely to report the greatest changes in opinions regarding the issues addressed. Therefore, another potential way to change viewer beliefs, and the cognitive components of their attitudes, is to create EE films that are *believable*. One way to achieve this goal is to include facts--statistics, charts, graphs, and expert interviews that address the environmental problem.

Results of this study show that a single viewing of an EE film can effectively increase a person's sense of threat and subsequently influence the affective components of attitudes. Visual film elements may be the most efficient way to influence the affective components of viewer attitudes. Many students in this experiment reported emotional reactions to images of dead fish used in the film; many students also found these graphic images to be the most powerful film element for changing their attitudes regarding the Delta ecosystem. Fortner (1985) found that documentary films have the ability to influence viewer attitudes in ways that other teaching formats cannot. Unlike Fortner's (1985) experiment, this study only included one treatment condition (viewing of the documentary film); therefore, a comparison of the film's effects on student attitudes against effects of other teaching methods is not possible. Future research should explore which teaching format is the most influential in promoting desired outcomes.

Future research efforts should also examine how EE films affect viewer behaviors. Specifically, EE films that instill a sense of personal responsibility, teach specific action strategies, and outline clear solutions regarding environmental problems. Possible research question for future studies are as follows: Will an EE film, which instills a sense of personal responsibility, lead to an increase in pro-environmental behaviors among viewers? Will an increase in pro-environmental behaviors lead to an increase in sense of personal responsibility? What happens to a learner's locus of control when they become involved in pro-environmental behaviors? Answers to these questions may help educators design more powerful EE films that can reach the masses and encourage desired responses among viewers.

The Model of Pro-environmental Behavioral Intentions was more explanatory than Hine's Model (Hines et al., 1986) for the purpose of this study. The former model isolated perception of threat, which proved to be a key factor in influencing both pre- and post-viewing pro-Delta attitudes and behavioral intentions. Hine's Model (Hines et al., 1986) would prove more explanatory for studies measuring action skills, knowledge of action strategies, situational factors, and responsible environmental behavior. Future EE film research may consider a hybrid of both models to see how perception of threat influences actual behaviors.

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Appendix 1: The Sacramento-San Joaquin Delta and California Water Projects

California's Sacramento-San Joaquin Delta (the Delta) is an integral component of the San Francisco Bay-Estuary--the largest estuary on the western coasts of both North and South America (PPIC, 2007; Strange, 2008; Norgaard et al., 2009). Fanning out at the confluence of the southwest-flowing Sacramento River and the northwest-flowing San Joaquin River, the Delta receives runoff from approximately 40% of the land area and 50% of the total stream flow in California (Strange, 2008). Water diversions from the Delta account for roughly 40% of California's "plumbed" water use (Norgaard et al., 2009). Over 22 million Californians rely on the Delta to meet some or all of their drinking water needs (PPIC, 2007). Fish and migratory birds are also dependent on the Delta's critical habitat (Norgaard et al., 2009); over 700 species of native flora and fauna find refuge in the Delta (DFG, 2010). Moreover, approximately 80% of California's salmon fishery, which is second only to Alaska's, depends on the Delta's habitat for survival (Strange, 2008); and the Delta smelt is found nowhere else on earth except for the Sacramento-San Joaquin Estuary (DFG, 2010).

Experts and stakeholders agree that the Delta is a fragile ecosystem and on the brink of collapse (Mount & Twiss, 2005; PPIC, 2007; Strange, 2008, Norgaard et al., 2009; Kallis et al., 2009); multiple attempts have been made to resolve this problem (Sze et al., 2009; Lejano & Ingram, 2009; Shilling, London & Lievanos, 2009; Owen, 2009; Hanemann & Dyckman, 2009; Taylor & Short, 2009). In order to craft a recovery plan to halt and negate the historical decline of this ecosystem, however, it is first necessary to

understand the historical transformation of the Delta brought about by human modification (Owen, 2009; Sze et al., 2009).

In their study on socio-natures and politics of scale, Sze et al. (2009) explain that understanding the Delta requires knowledge of not only its historical geography, but also its environmental history shaped by "large-scale human intervention." Anthropogenic modification of the Delta is a relatively recent phenomenon, occurring only after European settlement in the mid 1800's (Hanemann & Dyckman, 2009; Sze et al., 2009; Carter, 2009). Prior to this time, Native Americans lived peacefully in the Delta's natural environment: a tidal wetland, consisting of freshwater rivers and saline tidal waters (Sze et al., 2009; Carter, 2009). Rich Delta marshland covered over 2,500 square kilometers and served as "one of the richest ecosystems on the planet" (Strange, 2008). According to Mount and Twiss (2005), sediment core analyses provide evidence that the Delta was a tidal freshwater marsh for over 6,000 years.

However, large-scale human interventions disrupted this natural landscape beginning in 1848 with the discovery of gold in the American River (a tributary to the Delta) (Strange, 2008; Sze et al., 2009; Norgaard et al., 2009). California's gold miners were mindful that water was crucial for their enterprise, which provided an estimated $40-60 million in revenue each year (Littlefield, 1983). Miners without riparian rights began building ditches and diverting rivers for their dry diggings (Littlefield, 1983; Sze et al, 2009). Before long, minor ditches and water diversions evolved into large-scale engineering projects. By 1857, the state's canal and ditch system weaved across 4,405 miles and carried a total investment price tag of almost $11.9 million (Littlefield, 1983).

Mining operations altered the natural flows of California's waterways and released substantial amounts of debris into the river system (Hanemann & Dyckman, 2009). Hydraulic mining in the Sierras washed tons of sediments downstream, raising stream beds as much as six meters (Strange, 2008); mining debris reduced upstream freshwater inflow while debris-induced flooding rendered Sacramento Valley farmland useless (Hanemann & Dyckman, 2009).

Mining operations were not the only cause for water diversions during California's early years of statehood; disruption of the Delta's natural flows continued with the reclamation of swamplands for agricultural pursuits (Mount & Twiss, 2005; Strange, 2008; Sze et al., 2009). By 1900, reclamation activities diked, drained, and channeled 235,000 acres of rich peat Delta soils (Strange, 2008; Hanemann & Dyckman, 2009). By the 1930s, over 1,100 miles of levees divided the Delta into about 60 islands (Strange, 2008; Kallis et al., 2009). Reclamation of Delta swamplands into farmlands permanently altered habitat for fisheries as well as migratory waterfowl (Norgaard et al., 2009).

Further large-scale human interventions ensued as waterways were re-routed for irrigation projects (Sze et al, 2009; Hanemann & Dyckman, 2009). Beginning in the 1860s, water diversions for agricultural irrigation projects surpassed hydraulic mining as the most destructive anthropogenic force on the Delta's hydrology (Hanemann & Dyckman, 2009). Water supplies for Delta farmers and urban users were naturally low during the late summer months when runoff from snowmelt plummeted (Strange, 2008; Hanemann & Dyckman, 2009; Sze et al., 2009). Increased diversions of freshwater for

crop irrigation in the Sacramento Valley exacerbated this problem. As freshwater inflow to the Delta decreased, saltwater intrusion from the San Francisco Bay increased, and became the paramount concern for Delta stakeholders by the early 20th century (Hanemann & Dyckman, 2009).

In an effort to negate saltwater intrusion into the Delta, the Central Valley Water Project (CVP) was proposed in the 1930s, implemented in 1935 (Hanemann & Dyckman, 2009), and built in the 1940s and 1950s (Strange, 2008). One of the proposed functions of the CVP was to act as a hydraulic barrier that would repel saline waters from the San Francisco Bay by releasing sufficient volumes of freshwater into the Delta (Hanemann & Dyckman, 2009). Other objectives of the CVP were to meet agricultural and urban water needs and to provide flood protection (USBR, 2010). With a planned expansion the CVP, the State Water Project (SWP) was proposed (Hanemann & Dyckman, 2009). Built in the 1960s, the SWP was intended to provide additional flood control, reduce saltwater intrusion, supplement freshwater flows during times of peak water use, and provide water to agricultural and urban users (Strange, 2008; Sze et al., 2009).

Both the CVP and SWP have giant dams and reservoirs that trap and store runoff and then release this water into the Delta (Strange, 2008; Norgaard et al., 2009). Massive pumps lift this water from the Delta, distribute it through CVP and SWP aqueducts and canals, and transport it to California water users (Norgaard et al., 2009). An elaborate conveyance system carries water mainly from northern and eastern California to Central Valley agricultural interests and urban water users in the southern portion of the state (Hanemann & Dyckman, 2009). The Delta is the central conduit through which most of

the CVP and SWP water is transported (Strange, 2008; Kallis et al., 2009; Norgaard et al., 2009).

Due to these anthropogenic modifications, the Delta faces many formidable threats (PPIC, 2007). The Delta's levee system stretches across 1,100 miles across subsiding peat soils; these levees are vulnerable to failure from winter storm-induced floods and seismic activity (Mount & Twiss, 2005; Kallis et al., 2009). According to Mount and Twiss (2005), "scientists calculate a 2 in 3 chance of a catastrophic levee failure in the Delta… within the next 45 years." Recent estimates calculate a 90% change of catastrophic levee failure by the middle of this century (PPIC, 2008). Many Delta farms are as much as 15 feet below sea level (Mount & Twiss, 2005; Kallis et al., 2009), due to a combination of erosion, oxidation, and compaction (Zetland, 2010). Should the Delta levees fail, these farms would experience devastating flooding (Mount & Twiss, 2005; Zetland, 2010). Levee failure could compromise water supplies for the San Joaquin Valley, Southern California, and the Bay Area, as well, as salt-water intrusion would inevitably occur from the San Francisco Bay into the Delta (PPIC, 2008, Kallis et al, 2009).

Even without the threat of salt-water intrusion into the Delta from anticipated levee failure, the quality of Delta water supplies is still in jeopardy. Polluted runoff from urban, industrial, and agricultural sources carries organics, nitrates, mercury, pesticides, selenium and other toxics into the Delta (Norgaard et al., 2009; Kallis et al., 2009). According to Chow et al. (2003), the water that passes through the Delta contains elevated concentrations of dissolved organic carbon (DOC) and trihalomethane (THM)

precursor. An estimated 20-50% of DOC levels in the Delta are due to agricultural drainage from the Delta's peat soils (Chow, Tanji, & Goa, 2003). This water must be treated and cleaned up to potable standards prior to distribution to water users. During the treatment process, chlorine, added as a disinfectant, reacts with dissolved organic carbon to form THM, a known carcinogenic element (Chow et al., 2003). Numerous other chemical reactions occurring in Delta water supplies are still not understood (Zetland, 2010).

In addition to water quality concerns, water scarcity threatens Delta stakeholders. Over the last 50 years, the State's population has tripled and the economy has grown six fold (Norgaard et al., 2009). The majority of California's population depends on the Delta to meet some or all of their drinking water needs (Kallis et al., 2009). Agricultural interests, ranging from Delta farmers to Central Valley agribusinesses, occupy 7 million acres of land (Lejano and Ingram, 2009); they too have a vested interested in the Delta's water (Strange, 2008; Carter, 2009; USBR, 2010). Unfortunately, not all Delta stakeholders can receive their desired allocations. Historically, California's water agencies have over-allocated the amount of available water in the Delta's Central Valley watershed by approximately 850%. While this watershed has an average annual runoff of only 29 million acre-feet of water, the state has appropriated 245 million acre-feet of water rights (SWRCB, 2008).

Agricultural and urban water users are not the stakeholders vulnerable to anthropogenic modifications due to California's management of water resources. Native flora and fauna have also been placed in jeopardy as demonstrated by the death and

deformation of animals at the Kesterson National Wildlife refuge in the early 1980s (Garone, 1999). This disaster was due to improper drainage of irrigation water from the Western San Joaquin Valley, where the soils are laden with heavy metals including selenium, arsenic, and boron. This region is also notorious for its shallow groundwater table which can accumulate these heavy metals if irrigation water is not properly drained (Carter, 2010). The original plan for the CVP included the construction of the San Luis Drain to carry used irrigation water from this region to the San Francisco Bay. In the mid 1970s, just 85 miles of the proposed 188-mile drain were completed; budget constraints prohibited construction of the remaining 103 miles. The drain ended at Kesterson National Wildlife Refuge, and the irrigation water was released into the Kesterson Reservoir. By 1982, numerous bird deformities were discovered in the reservoir (Garone, 1999). All freshwater fish, except for mosquito fish, were found dead in the ponds of Kesterson. The selenium from agricultural drainage was promptly blamed for the widespread bird deformities and fish die offs (Carter, 2010).

Furthermore, current water management of the Delta has since created an artificially stable ecosystem which fosters proliferation of exotic competitors (PPIC, 2007; Strange, 2008; Norgaard et al., 2009; Zetland, 2010); of the 46 regularly occurring species in the Delta, 27 species are alien (Moyle, 2008). Operations of the CVP and SWP also alter the direction of flows in the Delta. Water that historically flowed west and through the Golden Gate is now pulled south by CVP and SWP pumps (Zetland, 2010); this artificially created reverse flow confuses migratory fish. Furthermore, the giant pumps that lift and export water from the Delta into the CVP and SWP canals also

ingest millions of fry and eggs (Walker & Storper, 1979). In December of 2007, the U.S. District Court ruled that these pumps harm the Delta smelt and ordered for operations that are more responsible to protect the Delta ecosystem (NRDC vs. Kempthorne, 2007). Given that similar adverse consequences resulting from pumping activities are suspected for salmon and steelhead, Judge Oliver W. Wanger recently ordered US Fish and Wildlife to craft Biological Opinions for these species as well (Zetland, 2010).

Current Events of the Delta: Review of Policy and Legislation

While experts have not reached consensus on how to resolve the critical problems of the Delta, experts agree that swift action is needed (PPIC, 2007; Strange, 2008; Norgaard et al., 2009; Kallis et al., 2009; Zetland, 2010). In his effort to combat these problems, Governor Schwarzenegger signed four policy bills and one $11.14 billion water bond in November 2009. Under the first policy bill, SB1 (7x), a seven-member Delta Stewardship Council was established for the purpose of developing a Delta Plan to guide state and local actions. The second bill, SB6 (7x), requires the Department of Water Resources to establish a schedule for monitoring groundwater basins, a feat which has never been accomplished in the State of California. A third key measure, Statewide Water Conservation, was established under SB7 (7x), which requires urban water agencies to reduce statewide per capita water consumption 20% by 2020. However, this bill requires no conservation from the agricultural sector! Lastly, SB8 (7x) provides for a stronger accounting of water diversions in the Delta and assessment of penalties on diverters who fail to submit required reports (Office of the Governor, 2010).

Though there is much language in these policy bills that sounds promising, many opponents question the intent of this legislation. Opponents object to the creation of the seven-member Delta Stewardship Council as established in SB1 (7x). While the policy bills do not contain specific language for the construction of the Peripheral Canal, Governor Schwarzenegger, who is openly pro-Peripheral Canal (Young, 2010), directly appointed the majority of the Delta Stewardship Council's members. Even though a sweeping majority of California's voters defeated The Peripheral Canal in the 1982 statewide election (PPIC, 2007), the seven-member commission could potentially approve its construction without voter approval. Furthermore, even before the Governor appointed council members, his administration actively recruited consulting firms to write a Delta plan that includes a Peripheral Canal or an underground tunnel to transport water around the Delta (Breitler, 2010). On April 27, 2010, Assemblywoman Alyson Huber, D-Lodi, brought a bill before California's lawmakers that would prohibit the construction of the Peripheral Canal, or any other project that would impact Delta water supplies, without legislative oversight. However, lawmakers (Associated Press, 2010) rejected this bill.

Another component of this legislation that opponents are leery of is the groundwater monitoring program created by SB6 (7x). In theory, this program is important, since over pumping in the Central Valley's aquifers is occurring at a rate of over 4.4 million acre-feet per year (Gleick, 2009b). However, critics of this bill consider it a "toothless" measure that lacks any enforcement authority. This bill also lacks requirements to measure, meter, or report actual groundwater use; without knowing how

to measure and report all water uses in California, a monitoring program will be a futile endeavor (Gleick, 2009a).

SB7 (7x) is criticized due to the fact that immediate water conservation is only required for the urban sector, which uses less than 20% of the state's developed water resources. Agricultural users, who use 80% of the same resource (Pacific Institute, 2008; Gleick, 2009b), are not required to meet conservation standards under this bill. Rather, they are required to submit an Agricultural Water Management Plan beginning on December 31, 2010, which outlines the conservation measures they intend to undertake (Office of the Governor, 2009).

Historically, California's agricultural sector had little incentive to conserve water due to the highly subsidized supplies they receive from government funded irrigation projects. Repayment of these projects remains unattempted. As of September 2005, agricultural contractors repaid a mere 18% of the original capital investment for the CVP (Pacific Institute, 2008), the largest publicly funded water management system in the country (Carter, 2009). The agricultural sector, the most consumptive water user in the state, received disincentives for conservation for over 70 years. Even modest attempts at conservation programs by agricultural users could save an estimated 0.6-3.4 million acre-feet of water every year without harming the productivity or profitability of this sector (Pacific Institute, 2008).

Opponents of the four policy bills fear the passage of the water bond could provide the necessary funding for many of the measures outlined above as well as $4 billion in funding for construction of new dams and expansion of existing ones. The

proposed Temperance Flat dam and off-stream Sites Reservoir would be built for the purposes of diverting water from the San Joaquin and Sacramento Rivers, respectively (Metropolis, 2010). Furthermore, opponents argue that the bond would foster the privatization of water resources in California. Lawmakers reason that the water bond's provision, which allows for the creation of joint power authorities that "may include in their membership governmental and nongovernmental partners…in financing the surface storage projects" (SB2 (7x), Cogdill, 2009), allows flexibility in financing water projects. However, if the water bond is passed, private companies could own and operate taxpayer-funded water projects and profit by selling the water back to the very taxpayers who paid for the systems (Buchanan, 2009).

Appendix 2: Review of Literature on Environmental Behavior Research

Study	Authors (Dates)	Research Objectives	Conclusions	Key Factors Thought to Influence Environmental Responses
Environmental knowledge and attitudes	Ramsey & Rickson (1976)	To investigate the relationship between attitudes and knowledge levels as they relate to environmental issues.	Knowledge of both ecology and economics is likely to lead to moderate rather than extreme positions on environmental issues; however, variation suggests that other variables, besides knowledge, influence attitudes.	-Knowledge -Attitudes -Emotions
Analysis and synthesis of research on responsible environmental behavior	Hines, Hungerford, & Tomera (1986)	To complete a meta-analysis of environmental behavior research in an effort to identify which variables are the most strongly associated with responsible behavior.	The Environmental Behavior Model was developed to predict environmentally responsible behavior based on these variables: cognitive knowledge, cognitive skills, personality factors, locus of control, attitudes, sense of personal responsibility, and situational factors.	-Knowledge -Attitudes -Locus of control/ empowerment -Personal responsibility -Action skills -Economic constraints -Social Pressures
Changing learner behavior through environmental education	Hungerford & Volk (1990)	To address the effectiveness of environmental education for promoting responsible citizenship behavior.	"…because all environmental behavior is somehow issue related, it appears as though issues must be the focus of instruction beyond environmental sensitivity, ecological foundations, and issue awareness," (p. 17).	-Environmental sensitivity (empathy) -Knowledge -Attitudes -Personal responsibility (ownership) -Action skills -Locus of control/ empowerment

Critical education and environmental management: Learning and empowerment for a sustainable future	Diduck (1999)	Explore the role of critical environmental assessment (EA) as a tool for managing the public involvement process.	Raising awareness of opposing interests or actions central to an environmental conflict is often the first step towards the solution to that conflict. "Conflict is a positive force when it identifies inadequate or misleading information," (p. 94).	-Locus of control/ empowerment -Action skills -Knowledge -Attitudes
Environmental education and attitudes: Emotions and beliefs are what is needed	Pooley & O'Connor (200)	To investigate whether cognitive or affective information, or a combination of both, is a better predictor of environmental attitudes.	Environmental educators interested in changing environmental attitudes need to target emotions and beliefs, rather than knowledge, for their EE programs. Cognition and affect differentially influence attitudes on unique issues.	-Emotions -Beliefs -Attitudes
Watershed pollution and preservation: The awareness-appraisal model of environmentally positive intentions and behaviors	Forsyth, Garcia, Zyzniewski, Story, & Kerr (2004)	To test the two-factor awareness-appraisal model which suggests that an individual's reactions to threatening circumstances are shaped by their awareness of the threat and their appraisal of the degree of threat the circumstances pose to them with regards to watershed conservation.	Results supported the awareness-appraisal model; respondents who were aware of their watershed and considered it polluted expressed the strongest pro-environmental behavioral intentions. Awareness alone is not enough to trigger pro-environmental behavioral intentions. Awareness paired with negative appraisal is a better predictor of behavioral intentions.	-Knowledge (awareness) -Beliefs -Values
Watershed conservation and preservation: Environmental engagement as helping behavior	Story & Forsyth (2008)	To test the awareness-appraisal-responsibility model; to examine the relationship between these variables and pro-environmental behavioral intentions.	Resident's awareness and appraisal of, as well as their sense of personal responsibility for, their local watershed are related to their pro-environmental behavioral intentions.	-Knowledge (awareness) -Beliefs (sense of imminent threat) -Personal responsibility -Locus of control/ empowerment

Self-determination theory as a guide to fostering environmental motivation	Darner (2009)	To use Self-Determination Theory (SDT) as an alternative research paradigm to fostering environmental motivation in the EE classroom.	"EE research has provided us with a collection of potentially useful predictors of pro-environmental behavior, but the field has yet to agree on an optimal set of predictors," (p. 41).	-Values (intrinsic motivation) -Locus of control/empowerment -Action skills

Appendix 3: Review of Literature on Environmental Education Through Audiovisual Media

Study	Authors (Date)	Research Objectives	Audiovisual Media Examined	Conclusions
Students' perception of environmental problems and sources of environmental information	Alaimo & Doran (1981)	To investigate selected factors (environmental concern, locus of control, knowledge about the environment, and sources of environmental information) that potentially influence the environmental values of students.	Television	Knowledge levels can influence attitudes. Locus of control can influence behavior and perceptions of events. "Nature programs, news reports on environmental change, and other documentaries keep students informed about environmental occurrences" (p. 21).
Effect of a Cousteau television special on viewer knowledge and attitudes	Fortner & Lyon (1985)	To examine whether television is an effective medium for communicating environmental information to the public; to determine if a single Cousteau documentary can increase viewers' knowledge levels or influence viewers' attitudes; to determine if these effects are retained.	Television Documentary	Viewer knowledge increased significantly and remained high for two weeks; mean retention post-test scores were significantly higher for treatment group than for control group. Viewer attitudes shifted towards the attitude goals of the producers. "By presenting in an attractive format the new pieces of information the communicator believes the audience should know, there appears to be a chance to increase knowledge levels and influence attitudes" (p. 19).
Relative effectiveness of classroom and documentary film presentations on marine mammals	Fortner (1985)	To compare the relative effectiveness of classroom instruction and a television program in providing knowledge and influencing attitudes about marine mammals; to compare attitude changes among viewers of the program and those who were taught the material in class.	Television Documentary	Comparable presentations in the classroom lecture setting and home viewing of the documentary resulted in similar gains in immediate posttest knowledge and retained knowledge. However, attitude changes were apparent only in the television treated group. Film elements are instructional and affective elements for EE.

A public's environmental information sources and evaluations of mass media	Ostman & Parker (1986)	To uncover the most frequently used mass media sources for environmental information; to determine which source people find most believable; to determine what the public's perception is of the quality of environmental content provided by journalists and newscasters.	Broadcast Journalism	Respondents cited newspapers and television as the most frequently used media sources; however, respondents claimed that other sources were more believable. As education increased, believability of television decreased. Respondents held negative evaluation of media personnel performance due to lack of balance, biased political orientation, and sensationalism.
Environmental concern, patterns of television viewing, and pro-environmental behaviors: Integrating models of media consumption and effects	Holbert, Kwak, & Shah (2003)	To evaluate how various television programs directly and indirectly influence the relationship between environmental attitudes and behaviors.	Public affair and nature documentary television shows	Both public affair and nature documentary use proved to be strong predictors of pro-environmental behaviors. "The attitudinal measure of environmental concern is by far the strongest predictor of pro-environmental behaviors" (p. 188). "There is a clear positive direct relationship between fact-based television use and individual level environmental activities" (p. 189).
The effect of nature documentaries on students' environmental sensitivity: a case study	Barbas, Paraskevo poulos, & Stamou (2009)	To understand the role nature documentaries play in students' environmental sensitivity (ES). To examine whether students exposed to a nature documentary on insects develop a greater level of ES towards those animals compared to students who have not.	Nature Documentaries	The use of documentaries significantly influenced students' attitudes and beliefs about insects as compared to students in the control group. ES manifested as a more positive emotional reaction to insects rather than as a perceived better understanding of insects. Although increased knowledge levels do not always lead to more pro-environmental behavior, it does help develop ES.

Appendix 4: Group Administered Survey

Demographic Questions:

What is your gender? ___ Male ___Female

How old are you? ___

What is your ethnicity?

___American Indian or Alaska Native ___Hawaiian or Other Pacific Islander

___Asian or Asian American ___Black or African American

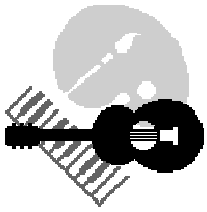
___Hispanic or Latino ___Non-Hispanic White

What is your current major/area of study?

What is your highest level of education completed?

How many years have you lived in California?

What activities do you enjoy in your free time?



Do you consider yourself an environmentalist?

True/False

1) California's Sacramento-San Joaquin Delta (the Delta) provides critical habitat for many of California's native species.	☐ True	☐ False
2) The Delta is a crucial component of California's water supply system that supplies water to urban and agricultural users in the state.	☐ True	☐ False
3) California has major water projects that capture natural flows of water, store that water, and then redistribute it to water users throughout the State.	☐ True	☐ False
4) The Delta's ecosystem of today closely resembles the Delta's ecosystem 200 years ago.	☐ True	☐ False
5) California's King Salmon are currently thriving in the rivers that feed into the Delta.	☐ True	☐ False
6) The urban sector accounts for roughly 80% of the developed water used in California.	☐ True	☐ False
7) Dams erected on California's rivers that flow to the Delta have had minimal impact of the health of the Delta ecosystem.	☐ True	☐ False
8) Large pumping facilities in the southern Delta pump Delta water uphill where it is then exported hundreds of miles to its final use.	☐ True	☐ False
9) State and Federal taxpayers subsidize the water that is sent from the Delta to agribusinesses in the Central Valley.	☐ True	☐ False
10) Farmers are not allowed to sell their subsidized water to developers for profit.	☐ True	☐ False
11) At times, the natural flows in the Delta have been cut by more than half due to water exports from the State and Federal Water Projects.	☐ True	☐ False
12) In order to keep the Delta ecosystem healthy, 70-75% of the natural flows must remain in the rivers that feed into the Delta.	☐ True	☐ False
13) Native and introduced fish species in the Delta are declining in numbers and, in some cases, are even going extinct.	☐ True	☐ False
14) Baby salmon are able to resist the suction caused by the pumps in the Delta and can easily find their way out into the Pacific Ocean.	☐ True	☐ False

Item Instructions: For each statement below, circle the number that best describes your level of agreement with that statement* ** Items 15-19 borrowed from Revised NEP Scale* (Dunlap, et al., 2000)	**Scale:** 1=strongly disagree 2=disagree 3=neither disagree nor agree 4=agree 5=strongly agree				
15) Humans have the right to modify the natural environment to suit their needs.	1	2	3	4	5
16) When humans interfere with nature, it often produces disastrous consequences.	1	2	3	4	5
17) Humans are severely abusing the earth.	1	2	3	4	5
18) The so-called “ecological crisis” facing humans has been greatly exaggerated.	1	2	3	4	5
19) Humans were meant to rule over the rest of nature.	1	2	3	4	5
20) California’s Delta has been overexploited by human activities.	1	2	3	4	5
21) There is not a lack of water in the Delta—there are billions of gallons of water that should be sent south to farms and urban users.	1	2	3	4	5
22) Water that passes under the Golden Gate Bridge and flows to the Pacific Ocean is wasted.	1	2	3	4	5
23) The pumps in the Delta should be turned off or reduced if they harm the population of king salmon.	1	2	3	4	5
24) We need to stop taking so much water from the Delta.	1	2	3	4	5
25) Water exports from the Delta should not be blamed for reduced fish populations.	1	2	3	4	5
26) If given the chance, I will vote for legislation that reduces the amount of water that is taken from the Delta.	1	2	3	4	5
27) I plan to take steps to protect California’s salmon.	1	2	3	4	5

28) I would vote against legislation that would allow for construction of new dams on rivers the feed into the Delta.	1	2	3	4	5
29) I would donate time/money to protect the Delta.	1	2	3	4	5
30) I will encourage my friends/family/coworkers to support legislation that protects the Delta ecosystem.	1	2	3	4	5
31) I feel I am personally responsible for protecting the Delta ecosystem.	1	2	3	4	5
32) It is not my responsibility to protect the salmon.	1	2	3	4	5
33) There is very little I can do to combat the decline of the Delta.	1	2	3	4	5
34) My efforts to restore the Delta would not make much of a difference.	1	2	3	4	5
35) No single person can do much to restore California's salmon fishery.	1	2	3	4	5
36) The Delta ecosystem is seriously threatened.	1	2	3	4	5
37) Polluted runoff from urban, industrial, and agricultural activities jeopardizes the Delta's water quality.	1	2	3	4	5
38) If the Delta ecosystem collapses, it will negatively affect the health and well-being of California residents.	1	2	3	4	5
39) If California's King salmon population goes extinct, California's economy will suffer.	1	2	3	4	5
40) If current management practices of the Delta continue, Californians will face serious water scarcity problems.	1	2	3	4	5

Questions 41-48 included on post-viewing surveys only.

Item Instructions: For each statement below, circle the number that best describes your level of agreement with that statement	**Scale:** 1=strongly disagree 2=disagree 3=neither disagree nor agree 4=agree 5=strongly agree				
41) The documentary film I just viewed provided equal voices to each group of stakeholders represented in the film.	1	2	3	4	5
42) I believe the documentary film I just viewed accurately portrayed the issues addressed.	1	2	3	4	5
43) The documentary film I just viewed was factual, balanced, and credible.	1	2	3	4	5
44) The documentary film I just viewed has changed my opinion on one or more of the topics covered.	1	2	3	4	5

Open-Ended Questions:

45) Did this documentary film teach you anything new about the issues addressed? If so, please list up to three issues that you learned about while viewing this film.

46) Did this film influence your attitudes regarding Delta ecosystem? Why or why not?

47) Did this film encourage you to take action to protect California's Delta and/or salmon population? Why or why not?

48) Which elements of this film did you find the most powerful at influencing your knowledge, attitudes, or intentions to act on the issues addressed?