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# The Effects of Marcellus Shale Natural Gas Development on Hunting, Fishing, and Other Recreational Activities Throughout Pennsylvania

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The Effects of Marcellus Shale Natural Gas Development on Hunting, Fishing,  
and Other Recreational Activities throughout Pennsylvania

by

Roxann R. Steelman

A Thesis

Presented to the Graduate and Research Committee

of Lehigh University

in Candidacy for the Degree of

Master of Arts

in

Environmental Policy Design

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This thesis is accepted and approved in partial fulfillment of the requirements for the Master of Arts in Environmental Policy Design.

The Effects of Marcellus Shale Natural Gas Development on Hunting, Fishing,  
and Other Recreational Activities Throughout Pennsylvania

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## **I. ABSTRACT**

Pennsylvania, along with portions of West Virginia, Virginia, Maryland, New York, and Ohio, set atop Marcellus Shale. The effects of Marcellus Shale natural gas drilling on hunting, fishing, and other recreational activities across Pennsylvania are currently unknown. Biological, recreational, and economical issues associated with the development of natural gas, along with the existing environmental guidelines for oil and gas activity on state forest lands from Pennsylvania's Department of Conservation and Natural Resources are currently being researched. An argument is made for the need to shift away from the current use of the Market Paradigm where cost-benefit analysis is used giving natural resources a monetary value and being traded as a commodity to one where the environment is recognized as an entire ecosystem with instrumental value essential to basic human wellbeing. This policy recommendation is important to states in the early stages of natural gas development, such as Ohio and New York.

## **II. INTRODUCTION**

Pennsylvania, along with portions of West Virginia, Virginia, Maryland, New York, and Ohio, set atop a rock formation known as Marcellus Shale. It has been estimated the Marcellus shale formation contains ones of the largest gas fields in the world, second only to the South Pars field in Qatar and Iran (Considine, 2010).

Pennsylvania is no stranger to the oil and gas industry. Colonel Edwin Drake drilled the first North American oil well in Titusville, Pennsylvania in 1859 (The Paleontological Research Institution, n.d.). While the richness of the Marcellus gas reserve has been known for years, it was not until advancements in hydraulic fracturing technology, or fracking, that it became economically feasible to retrieve the gas. According to Johnson (2010), the Commonwealth of Pennsylvania is at the epicenter of Marcellus Shale natural gas development. This can be seen by the number of well permits issued by Pennsylvania's Department of Environmental Protection to various gas companies: in 2008 – 476; 2009 – 1,984; 2010 – 3,314, a 67% increase over 2009; and, between January 1 and June 17, 2011 - 1,526. The number of wells drilled have also increased over this same time frame: in 2008 – 364; 2009 – 795; 2010 – 1,146; and, as of June 17, 2011 – 745. The largest numbers of permits issued have been across Pennsylvania's northern tier in Bradford, Susquehanna, and Tioga counties, and across the southern region in Washington and Greene counties. It has been estimated there are trillions of cubic feet of natural gas within the Marcellus Shale natural gas play (Governor's Marcellus Shale Advisory Commission Report [Governor's Report], 2011; Considine, 2010).

The number of wells drilled across Pennsylvania, as indicated above, far surpasses the number of wells drilled in other states underlain by Marcellus Shale. This is especially true in West Virginia. In 2008, only 297 wells were drilled across West Virginia and in 2009, 411 (Considine, 2010). Clearly, Pennsylvania is leading the way with the speed at which Marcellus Shale natural gas is being developed across the Commonwealth.

The formation of the Marcellus Shale dates back more than 1.5 million years ago. To retrieve the gas that lies within the shale formation, an unconventional drilling process known as hydraulic fracturing is performed. A vertical well is drilled, then thousands of feet below the surface the well is drilled horizontally. Millions of gallons of water, along with chemical additives, are forced down into the well under massive amounts of pressure to split open the rock formation. Sand is then pumped into the well to hold open the cracks and release the gas. As the drilling fluids are withdrawn, the natural gas starts to flow and follows along behind the withdrawn fluids (Governor's Report, 2011).

Pennsylvania is home to one of the two largest natural gas fields – Marcellus Shale; Texas is home to the second– Barnett Shale. While there are similarities between these two gas fields, such as the end result of the gas extraction, there are also differences. One big difference is the actual size of the two fields. Marcellus Shale lies under approximately 118 million acres of land; while Barnett Shale lies under approximately 34 million acres. Texas has a relatively flat open dry landscape that stays moderately warm. Pennsylvania, on the other hand, has four seasons, with the winter season in Pennsylvania causing significant differences in the equipment used for drilling and the training for the gas workers. Pennsylvania's landscape is also full of mountain

ranges and millions of acres of forested lands, which requires different planning and preparation. Texas is considered the “worldwide hub” of the gas industry and has a streamlined procedure with the drilling process (Williams, 2011). Unconventional natural gas development is relatively new across Pennsylvania, with drilling regulations just recently beginning to take form and to be put into place.

The first Marcellus Shale natural gas well permit in Pennsylvania was issued in 2004 and drilling has increased rapidly across the Commonwealth since that time (Governor’s Report, 2011). The effects of Marcellus Shale natural gas drilling on hunting and fishing recreational activities within Pennsylvania are currently unknown. According to the U.S. Department of Interior Fish and Wildlife Service, in the fiscal year 2011, hunting, fishing and wildlife-related recreational activities were approximately a \$19 million recreational industry in Pennsylvania. This figure is based on the funds allocated to Pennsylvania from the Pittman-Robertson Wildlife Restoration Act and Dingell-Johnson Sport Fish Restoration Act. Pennsylvania placed third among all 50 states, the Commonwealth of Puerto Rico, Guam, the U.S. Virgin Islands, American Samoa, the Commonwealth of the Northern Mariana Islands, and the District of Columbia with funds received from the Pittman-Robertson Act, and eleventh from funds received from the Dingell-Johnson Act (U.S. Dept. of Interior, Fish and Wildlife Service, 2011a, b).

It is not only the economic benefits that make hunting, fishing, and other wildlife-related recreational activities important. Social bonding, companionship, and experiencing nature by spending time outdoors are other important factors (as cited in Hammitt, McDonald, and Patterson, 1990). People “escape” to nature to find solitude

and freedom from the stresses of everyday life and families pass along stories and traditions while spending quality time with one another (Wynveen, Kyle, and Sutton, 2012).

New energy development, such as natural gas, has been touted as a way for the United States to increase its energy security and reduce greenhouse gas emissions. Natural gas industry supporters across Pennsylvania promote increases in employment, financial security, regrowth of towns hardest hit by the recent recession, and an efficient, safe, and environmentally responsible way to supply Pennsylvania's citizens with all of their energy needs (Governor's Report, 2011). However, little research has been conducted on such topics as: the effects of forest fragmentation; natural habitat destruction; stream sedimentation; biodiversity loss; introduction of invasive species; extensive land use changes by natural gas development; and, how degradation to these natural areas are affecting hunting, fishing, and other recreational activities.

This thesis will research how a number of biological, recreational, and economical issues are currently being affected by the development of Marcellus Shale natural gas. Pennsylvania's Department of Conservation and Natural Resources current environmental guidelines for oil and gas activity on state forest lands will be critiqued to determine if these management plans are adequately protecting Pennsylvania's natural resources. Also, an argument will be made for the need to make a shift away from the current use of the Market Paradigm where cost-benefit analysis is used to give natural resources a monetary value and to be traded as a commodity, to one where the environment is recognized as an entire ecosystem with instrumental value that is essential to basic human wellbeing. This research is being completed in an attempt to lead to a

greater understanding of the impacts Marcellus Shale natural gas development has on hunting, fishing and other recreational activities, as well as the economy. The results of this research have the potential to inform hunting, fishing, and environmental policymakers' decisions regarding the continued development of Marcellus Shale natural gas across Pennsylvania.

### III. BIOLOGICAL ISSUES

It is widely known by ecologists and biologists that one of the greatest threats to the loss of biodiversity is habitat degradation (Molles, Jr., 2008). The development of energy resources such as Marcellus Shale natural gas, will affect Pennsylvania's fish and wildlife in some way (Belinda, 2011). While one must consider the impacts to all wildlife, including species such as the American black bear (*Ursus americanus*), migratory songbirds, amphibians, and native vegetation, this thesis discussion will focus on game species such as the white-tailed deer (*Odocoileus virginianus*), the wild turkey (*Meleagris gallopavo*), and native fish species, such as brook trout (*Salvelinus fontinalis*).

Anthropogenic actions have long altered the Earth's land surface. It is estimated between one-third and one-half of the land surface has received some form of human alteration (Kiesecker et al., 2009). An extraordinary loss of biodiversity has been the result of these actions. It has been predicted that between 10% to 30% of all bird, mammal, and amphibian species are threatened with the possibility of extinction due to these modifications (Kiesecker et al., 2009).

The continual rise in Marcellus Shale gas development across Pennsylvania is causing significant landscape changes. How hunting and fishing recreational activities are being affected by these changes are not immediately known. The Pennsylvania Chapter of The Wildlife Society issued a Position Statement on Marcellus Shale Gas Development in the Appalachians and High Allegheny Plateau (The Wildlife Society, Pennsylvania Chapter, n.d.), where they indicated wildlife biologists and managers are extremely concerned with the rise in natural gas development. The potential risks associated with this increased concern are:

- 1) Direct loss of terrestrial and aquatic habitats (esp. core interior habitats).
- 2) Increased fragmentation of terrestrial and aquatic habitats, preventing gene flow and reproduction of wildlife populations.
- 3) Introduction of barriers to dispersal for organisms such as amphibians.
- 4) Increased risk of sedimentation and chemical contamination of streams and wetlands.
- 5) Increased risk of chemical contamination of groundwater.
- 6) Increased noise, light and other pollution.
- 7) A spread of invasive plants, pests, and pathogens into native habitats.
- 8) Increased densities of habitat generalists such as opossums, raccoons, skunks, great horned owls, and white-tail deer.
- 9) Increased human access and disturbance, potentially leading to increased conflict and wildlife road mortality. (p. 1)

The Commonwealth of Pennsylvania is known for its excellent hunting and fishing opportunities and it stands to suffer significant losses due to Marcellus Shale natural gas development. The vast amounts of state game lands, state parks, and state forests provide the majority of the land areas and waterways conducive to hunting and fishing recreational activities. Privately owned lands provide the remaining areas. Fracking will happen on both.

Currently state game lands consist of 1.4 million acres, state forest lands of 2.2 million acres, and state park lands of 293,000 acres. Hunting activities take place on all state game lands, 2 million acres of state forest lands, and a portion of state park lands. Marcellus Shale underlies 1.5 million acres within the state forests and 211,000 acres within the state parks. As of 2011, 700,000 acres of the state forests' 1.5 million acres were available for gas production, with the Commonwealth leasing approximately 385,400 acres. The remaining acreage available for leasing is privately owned, as the Commonwealth of Pennsylvania does not hold ownership to the subsurface rights on approximately 290,000 acres. Natural areas, wild areas, and areas of sensitive ecological importance make up the approximately 800,000 remaining acres that are underlain by



Marcellus Shale. According to current Pennsylvania Department of Conservation and Natural Resource (DCNR) policy, this area is not offered for natural gas leasing (Governor's Report, 2011). As of the writing of the Governor's Report, Pennsylvania's current DCNR policy prohibits the Commonwealth from leasing any state park land to gas development. However, approximately 80% of the subsurface rights of the state park system are privately owned. To date there have been no unconventional Marcellus Shale natural gas wells drilled on state park land and private subsurface owners are encouraged to practice "non-development practices" (Governor's Report, 2011).

Fishing activities are available on all waterways located throughout the state land system. Pennsylvania is known for its native eastern brook trout populations, with the majority of these populations now confined to small mountain watersheds. Brook trout need clean cold water that is highly oxygenated; they are one of the prime indicator species of stream health due to their "very specific water chemistry requirements" (Trout Unlimited-Conserving coldwater fisheries, n.d.). Brook trout are highly sensitive to water temperature and water quality. Temperature, pH, and dissolved oxygen information on the Trout Unlimited website indicates brook trout prefer water temperatures less than 68°F, can tolerate pH levels as low as 5.0, and require water with relatively high concentrations of dissolved oxygen (Trout Unlimited-Conserving coldwater fisheries, n.d.) Marcellus Shale natural gas development has the potential to impact approximately 80% of the existing native brook trout watersheds (Johnson, 2010). Drilling activities that cause stream bank clearing will increase temperature levels causing decreased levels of dissolved oxygen and increase sedimentation which in turn can alter pH levels.

Marcellus Shale natural gas development brings many changes to the natural landscape. There are some that may only be concerned with the negative effects of the actual well pad associated with natural gas development; however, many other structures cause major disturbances as well. Determinantal effects are caused by roadways, storage facilities and tanks, pipelines, shops, compressor stations, traffic, power lines, and noise. To what extent these disturbances harm the wildlife located in and around these areas depends on the amount and extent of the disturbance, the ecological significance of the habitats under distress, and the location of the disturbance (Wyoming Game and Fish Department, 2010). These types of disturbances affect aquatic species, as well as terrestrial wildlife (Dunkin, Guthery, Demaso, Peoples, and Parry, 2009).

It has been estimated that by 2030 Marcellus Shale development could cause an additional 38,000 to 90,000 acres of forested lands to be cleared. This type of large-scale degradation has the potential of causing an even larger-scale impact to between 91,000 to 220,000 forested acres (Johnson, 2010). A major concern with forest clearing of this magnitude is the creation of new forest edge, an area where the forest meets a field or a new area such as a well pad or roadway. New edge has the potential of increasing light and humidity levels which promotes the introduction and expansion of invasive vegetation and the increased risk of predation (Johnson, 2010). As fragmentation of the forest continues, it creates smaller and smaller areas of forest isolation, which in turn affects the structure of the entire forest community (Molles, Jr., 2008).

The negative effects of these disturbances vary from species-to-species across the landscape. Species that require larger stretches of intact forest are especially vulnerable to harm from extensive forest fragmentation and the creation of new edge areas. Interior

forest birds such as scarlet tanagers (*Piranga olivacea*), black-throated blue warblers (*Setophaga caerulescens*), and northern goshawks (*Accipiter gentilis*), amphibians such as tree frogs and salamanders, mammals such as flying squirrels (*Glaucomys spp.*), along with differing types of woodland flowers are at risk of significant impacts. Many of these species require the protection of the tree canopy, shade, and higher humidity, which are all removed with forest fragmentation (Johnson, 2010).

Certain mammals, such as the white-tail deer, may actually do well in areas of new edge, as they are considered a generalist animal, and one that is resilient and can quickly adapt to changes (Unger, 2011). However, extensive forest fragmentation and land clearing may remove prime winter feeding areas causing animals to excessively gather in large herds and utilize marginal habitats. This displacement may lead to lower reproductive success, lower survival rates, diseases, and increased competition. Health of the entire white-tail herd could be at jeopardy with continual increases in natural gas development (Wyoming Game and Fish Department, 2010). Other species, such as the ruffed grouse (*Bonasa umbellus*) are considered a specialist species, and are not so lucky. Any significant changes to their habitat can cause detrimental impacts to this upland game bird (Unger, 2011).

The aquatic system is at risk of significant harm from landscape changes and forest fragmentation caused by Marcellus Shale natural gas development. As land is cleared, plant communities can change within a watershed area, this in turn can cause changes to the quality and quantity of water flow throughout a watershed. These changes can also lead to degradation of wetland areas. Wetlands provide important habitats for many species. Fish, amphibians, aquatic bird species, and insects all use wetland and

riparian areas as reproduction areas (Wyoming Game and Fish Department, 2010).

Hunting and fishing activities are conducted in and around wetland areas throughout Pennsylvania.

It is the speed and magnitude of the current Marcellus Shale natural gas development across the Commonwealth of Pennsylvania that has the significant potential of negatively impacting entire species and habitats. Pennsylvania is home to unique native brook trout habitats, vernal pools used by amphibians that are currently in decline around the globe, and crucial forested habitat needed for interior woodland species. Once these habitats are polluted or destroyed by natural gas development they are difficult, if not impossible, to replace (The Wildlife Society Pennsylvania Chapter, n.d.). These losses will in turn lead to decreases in the availability of hunting and fishing recreational activities throughout Pennsylvania. Detrimental effects to fish and wildlife may not be currently noticeable; however, as the current pace of Marcellus Shale natural gas development continues to increase it is certain to lead to greater and greater conflicts with wildlife (Sawyer, Kauffman, and Nielson, 2009).

Examples of forest fragmentation and new forest edge caused by Marcellus Shale natural gas development in the northern tier of Pennsylvania can be seen in the pictures below.



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**Figure 3.1 - Forest Clearing:**  
**The forest was removed for the installation of a new natural gas pipeline.**  
**There is the possibility of stream sedimentation due to run off**  
**and the possibility of temperature rise due to clearing.**



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**Figure 3.2 – Forest Clearing – Well Pad (1):**  
**An example of forest fragmentation and creation of new edge**  
**caused by the development of a natural gas well pad.**  
**Located in Band Rock Vista, Lycoming County, PA –**  
**within the McIntrye Wild Area of the Loyalsock State Forest**



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**Figure 3.3 – Forest Clearing – Well Pad (2):**  
**An example of forest fragmentation and creation of new edge**  
**caused by the development of a natural gas well pad.**  
**Located in Band Rock Vista, Lycoming County, PA –**  
**within the McIntrye Wild Area of the Loyalsock State Forest**



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**Figure 3.4 - Natural Gas Well Pad near Calvert, PA:  
An example of forest fragmentation, new edge, and soil compaction.**



Roxann R. Steelman – 2012

**Figure 3.5 - Rock Run in Loyalsock State Forest:  
Rock Run is known for its trout fishing.  
There is the possibility of stream degradation due to  
surrounding Marcellus Shale natural gas development.**

#### **IV. RECREATIONAL ISSUES**

The Commonwealth is not only known for its excellent hunting and fishing opportunities, but other recreational activities such as bird watching, hiking, camping, skiing, and canoeing/kayaking. The vast amounts of state game land, state parks, and state forests provide the majority of land areas and waterways conducive to these recreational activities. Outdoor enthusiasts know Pennsylvania for areas such as: Hawk Mountain for its location along a major migratory bird route; Cherry Springs State Park which offers views of the darkest skies east of the Mississippi River and is known as the best place along the eastern seaboard to study astronomy and to stargaze; Pine Creek Gorge located within the Tioga State Forest, better known as the Grand Canyon of Pennsylvania, and one of six National Natural Landmarks within Pennsylvania; water sporting activities along the Delaware and Susquehanna Rivers; and multiple skiing opportunities across the state (Pennsylvania Department of Conservation and Natural Resources [DCNR], 2012a, f). All of these pristine natural areas used for multiple recreational opportunities stand the chance of receiving some form of degradation caused by Marcellus Shale natural gas development.

Studies have shown that outdoor recreational activities are increasing in popularity with 97% of the population in the United States reporting they have participated in at least one form of outdoor activity. Walking is the most popular activity, with bird watching the fastest growing and camping, skiing, and trail activities gaining in popularity (Thapa, 2010). Hunting and fishing are particularly popular ways of interacting with nature, as indicated by the approximately 37 million Americans who participated in one or the other, or both, of these sports during 2011 (U.S. Fish and



Wildlife Service, 2012, August). In 2011, the Pennsylvania Game Commission sold 933,208 general hunting licenses: 880,818 to residents, and 52,390 to non-residents (Pennsylvania Game Commission, 2010a). The Pennsylvania Fish and Boat Commission sold 806,159 fishing licenses and 455,696 trout/salmon stamps in 2011: 733,559 general fishing licenses to residents, and 72,600 to non-residents (Pennsylvania Fish and Boat Commission, 2012a).

It has been shown early life hunting and fishing experiences as a youth, along with access to undisturbed rural natural areas, continue to influence involvement with these recreational activities into adulthood (Sofranko and Nolan, 2009). There are feelings of aesthetic beauty and solitude associated with pristine natural areas. People develop feelings of “place attachment” – individual identities or values associated with a particular environmental area. Over time as participation in outdoor activities, along with interactions with the natural environment increases, emotional bonds form between individuals and the areas (Wynveen et al., 2012).

According to Hammitt et al., (1990), in 1970 Driver and Tocher defined recreation, “as an intrinsically rewarding experience” (p. 335). A group of hunters were surveyed to determine what the most important aspect of their hunting experience was and it was established being in the outdoors was more important than the actual harvesting of a deer (Hammitt et al., 1990). An area lacking any form of man-made structures is an important characteristic with outdoor recreation. Being surrounded by pristine wild areas gives feelings of “freedom” or “escape” from everyday life (Wynveen et al., 2012).

The large amount of public lands across Pennsylvania that have been available for multiple forms of outdoor recreational activities in the past is at risk of being lost, or at the very least, having access limited. As the Bureau of Forestry and private mineral-rights owners continue to increase the number of gas leases throughout state forestlands, areas that were once available to sportsmen and women will no longer be accessible and available for outdoor recreational activities. Private lands once made available for lease to sporting clubs are also seeing impacts from Marcellus Shale gas development; access is being restricted or leases are not being renewed (Sportsmen Alliance for Marcellus Development, n.d.).



Roxann R. Steelman – 2012

**Figure 4.1 - Sugar Camp Road, Calvert, Lycoming County, PA:  
An example of a new Marcellus Shale natural gas well drilling site  
showing forest fragmentation, noise and light pollution,  
visual disturbance, and area restrictions.**

As development of Marcellus Shale natural gas continues to escalate, more and more pristine, wild areas will continue to vanish from across the Commonwealth. The landscape will change from one of uninterrupted forestlands to one fragmented with industrialization. The solitude and isolation sought after by so many outdoor recreationists will diminish and be replaced by elevated levels of noise caused by the continual hum of drilling activities, heavy truck traffic, and compressor stations. The sight of active well pads will continue to replace the uninterrupted mountain vistas so many come to Pennsylvania during all months of the year to enjoy. The continued pace of natural gas development will forever change the character of a region thought of by so many outdoor recreationists as wild areas of pristine beauty to one of large-scale industrialism (Rumbach, 2011).

## **V. ECONOMIC ISSUES**

A true economic value cannot be placed upon the environment and the wildlife within it. However, that is exactly what is done in today's society. The use of the cost-benefit analysis paradigm is used to determine how much it is worth to retrieve the natural gas underlying approximately 60% of Pennsylvania versus the benefit of saving Pennsylvania's declining natural resources. Economists include recreational activities as an economic good and are able to subject those activities to economic analysis (Wennergren, Fullerton, and Wrigley, 1977). According to a report issued by Goodrich, Brittingham, Bishop, and Barber (2004), a survey conducted by PennFuture in 2001 indicated 73% of the voter's in Pennsylvania stated, ". . . there is no need to choose between the environment and the economy" (p. 25). Biological literature and political discourse indicate this is happening across Pennsylvania with the current state and speed of Marcellus Shale natural gas development.

Pennsylvania is known for the areas across its northern tier identified as the Pennsylvania Wilds. These areas are currently receiving some of the fastest development of Marcellus Shale natural gas. Recreational activities such as hunting and fishing across the Pennsylvania Wilds, as well as other locations across the Commonwealth, produce substantial economic returns (Pennsylvania Game Commission, 2010b).

According to the Pennsylvania Tourism website, Travel USA's annual survey of U.S. travelers determined Pennsylvania to be the third most popular destination for people taking day-trips and fifth most popular destination for over-night travelers. In 2010, approximately 179.2 million people visited Pennsylvania, with 62% of those visitors being residents of other states. Survey respondents indicated three of the reasons

for traveling to Pennsylvania were its scenic drives, beautiful scenery, and availability of outdoor activities. Hunting, backpacking, river rafting, skiing/snowboarding, and canoeing/kayaking were among the popular outdoor activities for requiring overnight stays. When asked why the Pennsylvania Wild's areas were visited, it was determined that the great opportunities for nature is what attracted visitors. Some of the top reasons for sightseeing across Pennsylvania were: great wilderness areas; truly beautiful scenery; excellent state parks; and, great place for birding/nature viewing. Some of the top reasons for sports and recreation across the Commonwealth were its availability of: great camping areas; excellent fishing; good places for skiing/winter sports; and its excellent hunting (PA Tourism, n.d.). All of the reasons listed above for why travelers visited Pennsylvania may be negatively impacted by Marcellus Shale natural gas development.

The tourism sector of the economy creates multiple jobs and monetary, as well as non-monetary, benefits across the Commonwealth of Pennsylvania. According to Rumbach's (2011) report on the potential impacts of Marcellus Shale natural gas drilling on the tourism economy across the southern tier of New York:

Most important, tourism amenities improve the quality of life of residents. Restaurants, shops, parks and outdoor recreation areas, campgrounds, wineries, festivals, museums, and other related amenities are beneficial to local residents as well as visitors. . . . The preservation and maintenance of rural and outdoor assets is also an import component of sustainable economic development strategies. (p. 9)

The three areas reported on in Rumbach's study lie along the border of Pennsylvania and New York, directly above Bradford and Tioga counties, two of the hardest hit counties by Marcellus Shale natural gas development in Pennsylvania. The areas in both states have "similar topography and environment . . . [both] econom[ies] ha[ve] important agriculture

and tourism sectors” making Rumbach’s information relevant for many portions of Pennsylvania (Rumbach, 2011, p. 3).

Many local small businesses rely heavily on the revenues received from the tourism industry. While the boom of the gas industry during the initial stages of natural gas development has generated substantial revenues for many of these small town businesses, this short-term gain may not be sustainable over the long-term. Degradation caused by natural gas well development, along with damages caused by the surge of out-of-town workers, may impact the natural experiences sought after by so many visitors and cause them to choose places outside of Pennsylvania for their travel destinations (Rumbach, 2011).

The Federal Aid in Wildlife Restoration Act (16 U.S.C. 669-669i; 50 Stat. 917) of September 2, 1937, as amended, is more commonly referred to as the Pittman-Robertson Act. This Act provides Federal aid to states from funds received from excise taxes placed on sporting arms and ammunition, pistols and revolvers, bows, arrows, and their parts and accessories. These funds are used by the individual states for projects and activities to acquire and improve wildlife habitat, research into wildlife problems, introduction of wildlife into suitable habitats, hunter education and safety programs, and comprehensive fish and wildlife management plans (U.S. Fish & Wildlife Service, 2012b). The Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777k, 64 Stat. 430), of August 9, 1950, as amended, is more commonly referred to as the Dingell-Johnson Act. This Act provides Federal aid to States from funds received from excise taxes placed on sport fishing tackle, fish finders, electric trolling motors, and import duties on fishing tackle, yachts and pleasure crafts. These funds are used by the individual states for projects and

activities for the restoration and management of fish having “material value in connection with sport or recreation in the marine and/or fresh waters of the United States”. These projects can include the acquisition and improvement of sport fish habitat, research into fishery resource problems, wetlands restoration, surveys and inventories of sport fish populations, the stocking of fish, aquatic education, development of access facilities for public use, and boat safety and clean vessel sanitation devices (U.S. Fish & Wildlife Service, 2012a). Between these two Acts, over \$10 billion has been divided amongst all of the states for fish and wildlife conservation (Williams, 2010). For fiscal year 2010, Pennsylvania alone received approximately \$19 million from funds generated from these two Acts for hunting, fishing, and wildlife-related recreational activities: Pittman-Robertson Act – approximately \$13.4 million; Dingell-Johnson Act – approximately \$8.3 million (U.S. Dept. of Interior, Fish and Wildlife Service, 2011a, b).

Every five years the U.S. Fish and Wildlife Service conducts a national survey based upon data collected by the U.S. Census Bureau to determine the importance citizens of the United States place on wildlife-based recreational activities. The survey estimated 90.1 million Americans 16 years and older (38% of the U.S. population) spent approximately \$145 billion in 2011 on some form of wildlife related recreational activity. This spending equates to 1% of the gross domestic product – one out of every \$100.00 spent on all services and goods produced in the United States is due to recreation that is wildlife related. It was estimated over 37 million people spent time hunting, fishing, or both, while the remaining were engaged in such wildlife watching activities as photography, close observation, or feeding of wildlife. In 2011, wildlife watchers spent over \$55 billion on activities. Sportsmen and women spent over \$90 billion, broken

down as follows: equipment - \$43.2 billion; trips - \$32.2 billion; and, licenses and fees, membership dues, and contributions - \$14.6 billion. While the survey results pertained to Americans 16 years of age and older, it was estimated that in 2011, 8.5 million people 6 to 15 years of age fished, 1.8 million hunted, and 11.7 million watched wildlife (U.S. Fish & Wildlife Service, 2012, August).

A further breakdown of the National Survey data revealed hunting accounted for 13.7 million people (6% of the national population), each spending on average 21 days pursuing some form of wild game, both large and small. Hunters spent approximately \$34 billion, with expenditures averaging approximately \$2,484 per hunter. Fishing accounted for 33.1 million people (14%), each spending on average 17 days fishing. Anglers spent approximately \$41.8 billion, with expenditures averaging approximately \$1,261 per angler. Wildlife watching accounted for 71.8 million people; 68.6 million participating from their homes (29%) and the remaining 2.5 million (9%) participating in trips away from home. On average the trips wildlife watchers took away from home lasted 15 days. Wildlife watchers spent approximately \$55 billion, with expenditures averaging approximately \$765 per wildlife-watcher. Pennsylvania was the fourth state with the highest level of in-state participants for hunting and the fifth state with the highest level of in-state participants for wildlife watching; 775,000 and 3,598,000 participants respectively (U.S. Fish & Wildlife Service, 2012, September).

According to the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation State Overview from the U.S. Fish and Wildlife Service, the breakdown of preliminary expenditures for fishing, hunting, and wildlife-watching



activities for the United States and the Commonwealth of Pennsylvania are listed in

Table 5.1.

<b>Preliminary Expenditures By State Where Spending Took Place: 2011</b> (Population 16 years old and older. Expenditures in thousands of dollars)										
<b>FISHING:</b>										
State where spending took place	Trip-related expenditures				Expenditures for equipment					
	Total expenditures	Total trip- related	Food and Lodging	Transportation	Other trip costs	Total equipment	Fishing equipment	Auxiliary equipment	Special Equipment	Expenditures for other items <sup>1</sup>
<b>U.S. Total</b>	41,573,783	21,789,465	7,711,318	6,261,536	7,816,610	15,311,177	6,141,895	1,106,865	8,062,417	4,473,141
<b>Pennsylvania</b>	484,996	228,510	76,705	83,154	68,651	193,879	14,099	*12,696	...	62,607
<b>HUNTING:</b>										
<b>Hunting Equipment</b>										
<b>U.S. Total</b>	31,445,032	10,421,189	3,881,304	4,767,915	1,771,970	13,606,133	7,738,324	1,844,880	4,022,929	7,417,711
<b>Pennsylvania</b>	976,662	172,710	61,534	98,835	*12,342	563,664	319,457	100,525	...	240,287
<b>WILDLIFE-WATCHING:</b>										
<b>Wildlife- Watching Equipment</b>										
<b>U.S. Total</b>	50,347,942	17,274,675	9,349,439	6,006,860	1,918,376	24,287,628	10,467,983	2,410,570	11,609,075	8,585,639
<b>Pennsylvania</b>	1,225,236	266,669	203,405	58,372	...	742,934	290,509	*91,338	...	215,632
*Estimates based on a sample size of 10-29. ...Sample size too small (less than 10) to report data reliably <sup>1</sup> Includes expenditures for magazine subscriptions, membership dues and contributions and leasing and ownership										

**Table 5.1 - Preliminary Expenditures for Fishing, Hunting, and Wildlife-Watching  
U.S. Fishing and Wildlife Service  
2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation  
State Overview**

Hunting, fishing, and other outdoor wildlife activities will continually contribute to the economy of Pennsylvania. The economic value gained by the extracted Marcellus Shale natural gas will eventually be gone as the energy resources are used up. However, wilderness, wild areas, and wildlife will continue to have limitless value for future generations, but only if these areas and species are protected and preserved. The survival of many small businesses across Pennsylvania depends on the revenue generated by current hunting, fishing, and other outdoor activities. With the speed at which Marcellus Shale natural gas development is currently taking place, and if forested pristine, wild areas across Pennsylvania continue to decline, recreationist will take their hunting, fishing, and wildlife-watching dollars to other states.

The passing of Act 13 imposed an unconventional gas well fee, or better known as impact fees, that every natural gas producer across Pennsylvania must pay (Governor's Report, 2011). The Pennsylvania Public Utility Commission (UPC) is responsible for collecting and distributing these funds to the counties, local municipalities, and other agencies per Act 13. According to the UPC's website, the first round of impact fees have been collected and the revenue generated per Act 13 for 2011 was over \$204 million (Pennsylvania Public Utility Commission [UPC], 2012). Olson (2012) reported in an article for the Pittsburgh Post-Gazette that the estimation for the initial collection of fees could amount to \$180 million. The actual fees collected far surpass this estimate.

These economic benefits of Marcellus Shale natural gas development to the Commonwealth of Pennsylvania cannot be denied, but what costs must Pennsylvania citizens pay to receive these gains? Natural resources cannot be separated into individual pieces to be traded as commodities. The personal or spiritual benefits received from spending time in and with nature cannot be replaced by economic gains. No price can be placed upon the benefits gained when families are able to spend quality time together participating in recreational activities such as fishing or hunting.

## **VI. REGULATIONS**

The significance of the natural resources across the Commonwealth can be seen as far back as the Constitution of Pennsylvania where in Article 1, Natural Resources and the Public Estate, Section 27 it states:

The people have a right to clean air, pure water, and the preservation of the natural, scenic, historic and esthetic values of the environment. Pennsylvania's public natural resources are the common property of all the people, including generations yet to come. As trustee of these resources, the Commonwealth shall conserve and maintain them for the benefit of all the people. (Pennsylvania, 2012, p. 5)

To protect and maintain Pennsylvania's vast natural resources multiple agencies have been established. The Pennsylvania Department of Environmental Protection's (DEP) mission is to protect the land, air, and waters of Pennsylvania from pollution and to provide a cleaner environment for the safety and health of the citizens of Pennsylvania. The DEP is responsible for the administration of the environmental laws and regulations throughout Pennsylvania. For example, DEP's responsibilities include reducing air pollution, protecting water quality in rivers and streams, and ensuring drinking water is safe (Pennsylvania Department of Environmental Protection, 2012a). The Department of Conservation and Natural Resources (DCNR) was established to preserve and maintain the 120 state parks and the millions of acres of state forestlands; this is accomplished through the Bureau of Parks and Bureau of Forestry, respectively. DCNR is charged with providing information on the ecological and geological resources throughout the Commonwealth, conserving natural resources, managing the lands of the state parks and forests sustainably, and improving access to quality recreational resources throughout the state park and forest system (DCNR, 2009c). The Pennsylvania Fish and Boat

Commission (PFBC) was established to conserve, protect and enhance the aquatic resources throughout the Commonwealth and to provide boating and fishing opportunities (PFBC, 2012b).

The Commonwealth of Pennsylvania has the largest span of public state forestland in the eastern part of the country. When the Department of Conservation and Natural Resources Bureau of Forestry (BOF) updated their State Forest Resource Management Plan in 2007, they indicated the state forestland is the “largest publicly owned habitat for plants and animals in the Commonwealth of Pennsylvania”. In 2003 the Bureau of Forestry revised how they manage the forest to an ecosystem management-based approach. This approach to management recognizes the importance of all aspects of the ecosystem and one where it is understood that in order to sustain the ecosystem’s structure, function, and composition over the long run it is essential that decisions be centered around the best understanding of ecological interactions and processes (DCNR, 2009b).

All three of Pennsylvania’s environmental agencies, DEP, DCNR, and PFBC, have the responsibilities of protecting Pennsylvania’s air, land, and water, preserving the parks and forests, conserving the natural resources, and improving the quality of recreational resources. An ecosystem-based approach to management is supposed to provide natural resource protections such as these. Marcellus Shale natural gas development is removing quality wildlife habitat, causing stream sedimentation, and has the potential of polluting water sources. These environmentally degrading impacts caused by fracking, and other natural gas development processes, are not being recognized; therefore, the Bureau of Forestry’s ecosystem-based management approach is

not currently providing the environmental protections, nor is it considering the importance of all aspects of the ecosystem.

In an effort to enact stronger environmental standards concerning the drilling of unconventional gas wells, along with other requirements, on February 14, 2012, current Pennsylvania Governor Tom Corbett signed into law House Bill No. 1950, better known as Act 13 (DEP, 2012b). Chapter 32, Subchapter A, § 3202 Declaration of Purpose states that one of the reasons for the chapter is to, “Protect the natural resources, environmental rights and values secured by the Constitution of Pennsylvania” (p. 46). Subchapter B, General Requirements, sets out restrictions for withdrawing or using water from water sources in the Commonwealth for hydraulic fracturing, well locations, required setbacks from streams, springs, or other bodies of water, wetlands and reservoirs, and indicates “best practices” *should be used* [emphasis added] to ensure environmental protections, along with other numerous issues. § 3215 – Well location restrictions, (c) Impacts, specifically states:

On making a determination on a well permit, the department *shall* [emphasis added] consider the impact of the proposed well on public resources, including, but not limited to:

- (1) Publicly owned parks, forests, game lands and wildlife areas.
- (2) National or State scenic rivers.
- (3) National natural landmarks.
- (4) Habitats or rare and endangered flora and fauna and other critical communities. (p. 74)

However, Act 13 does not specifically indicate the oil and gas industry *must* follow the indicated recommendations. The recommendations are merely given as suggestions to the oil and gas industry on what the Commonwealth would like to see followed during natural gas drilling and development. In order to not deny oil and gas companies the

economic gains of reaching and retrieving the natural gas underlying their leased areas, these gas companies can request variances to DCNR's recommendations by providing DEP with plans for alternative measures (DCNR, 2009b; DEP, 2012b).

Chapter 33, Local ordinances relating to oil and gas operations, § 3303 Oil and gas operations regulated by environmental acts, indicates the Commonwealth “preempts and supersedes the local regulation of oil and gas operations regulated by the environmental acts” (p. 162); therefore, denying local governments the ability to impose current regulations to ensure adequate environmental protections (DEP, 2012b). Representatives from seven municipalities throughout Pennsylvania filed suit indicating Act 13 was specifically taking away the abilities of local governments to control oil and gas operations. The state Commonwealth Court ruled in July 2012 the zoning aspects of Act 13 were in violation of the state constitution. Governor Tom Corbett has appealed this ruling to the Supreme Court (Begos, 2012).

In 2011, the Bureau of Forestry released their Guidelines for Administering Oil and Gas Activity on State Forest Lands (Guidelines) where they indicated exploration and development of oil and gas would be conducted in ways that minimized unfavorable impacts to the flora, fauna, water, and soil on state forestlands. Setbacks restrictions for gas activities are indicated for such things as water sources, wetlands, vernal pools, picnic and shelter areas, trails, overlooks and vistas, and boundary lines of state parks and wild and natural areas. Throughout the Guidelines, BOF indicates the importance of thinking about long-term environmental implications, the need for long-term restoration goals during the early planning processes, and the importance of using “best management practices” throughout all stages of gas drilling and development. When a thorough

review of the Guidelines are made, one can see BOF merely indicates what *should* be done, not what *must* be done; i.e.: “Operations *should be* [emphasis added] scheduled to avoid conflicts with visitors (i.e., hunting seasons and holiday weekends) and critical wildlife nesting or mating seasons” (p. 18). As indicated in the Position Statement issued by the Pennsylvania Chapter of The Wildlife Society, the best management practices recommended by DCNR have not “been subjected to research to determine their effectiveness” (The Wildlife Society Pennsylvania Chapter, n.d.). BOF does make one clear and precise exclusion to oil and gas activities where they indicate (DCNR, 2009b):

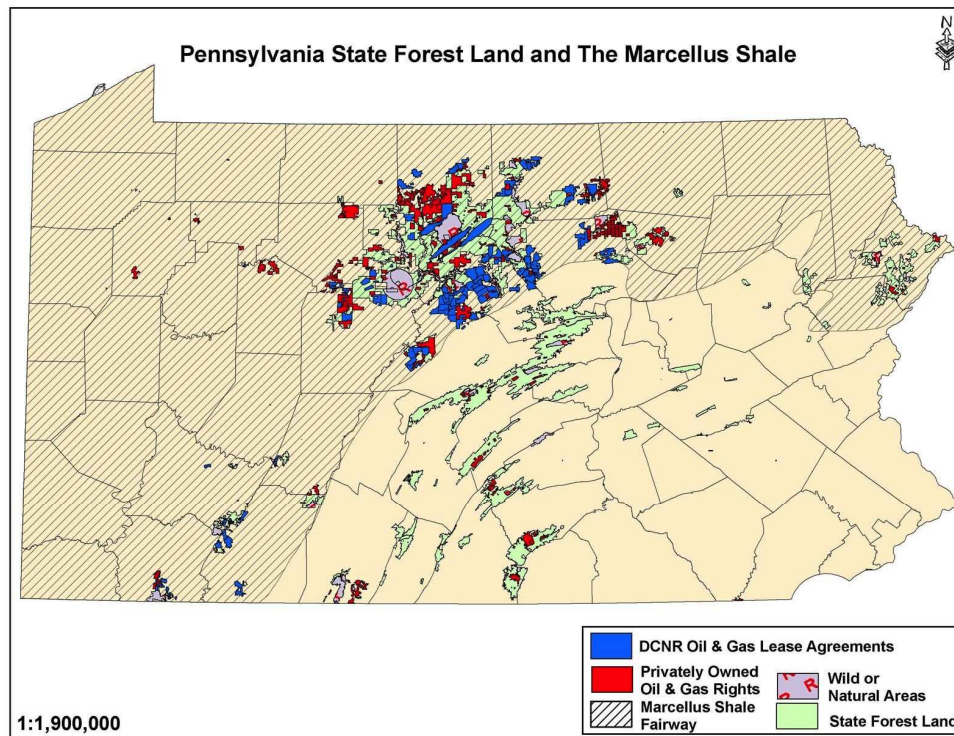
**Note:** No oil and gas activity of any kind, including but not limited to drilling, pipeline or road construction, shall be permitted, nor shall they be subject to waivers, on the surface of State Forest Wild or Natural Areas or within State Parks where the Commonwealth owns the oil and gas rights. (p. 15)

This exclusion only affects the land areas where the Commonwealth owns the mineral rights. Private mineral rights owners are free to lease their rights to the natural gas that may be underlying lands within the State Forest Wild Areas, Natural Areas, or within State Parks.

The BOF’s Guidelines recognize the unique recreational opportunities available to in and out of state citizens throughout state forestlands. BOF indicates they recognize natural gas activities will cause an increased potential for many impacts and conflicts with recreationists’ activities. While BOF has issued policies and considerations that are intended to minimize the potential impacts and/or conflicts with recreationists, once again the only real activities prohibited are mineral development, leases, and new rights-of-way on designated state forest wild and natural areas where the Commonwealth owns the subsurface mineral rights. Additionally, when oil and gas operators are going to be

performing flaring activities (the burning off of excess gases at well pads) in close proximity to the dark areas of Cherry Springs State Park, operators must provide the State Forest District Manager with a minimum of 10 days notice. The District Manager can then *encourage* the operators to modify their flaring activities to decrease the possibilities of conflicts. Also, exactly what is considered “proximity to designated Dark Sky Areas” (p. 60) is not established (DCNR, 2009b).

The magnitude of oil and gas leasing across state forestlands can be seen on the map in Figure 6.1 below retrieved from the DCNR website:



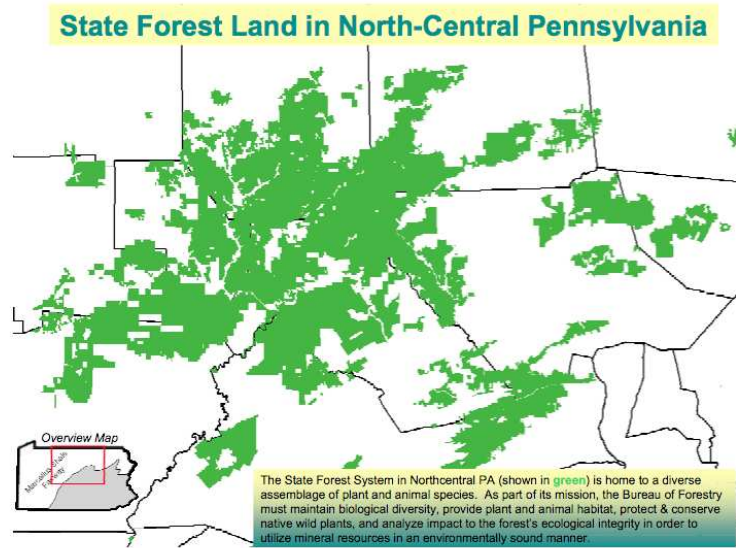
(DCNR, 2009e)

**Figure 6.1 – Pennsylvania State Forest Land & The Marcellus Shale**

DCNR has released maps indicating the amounts of surface disturbances and how leasing additional state forestlands to natural gas development would impact the sustainable balance DCNR is charged with maintaining. The map in Figure 6.2 shows a portion of

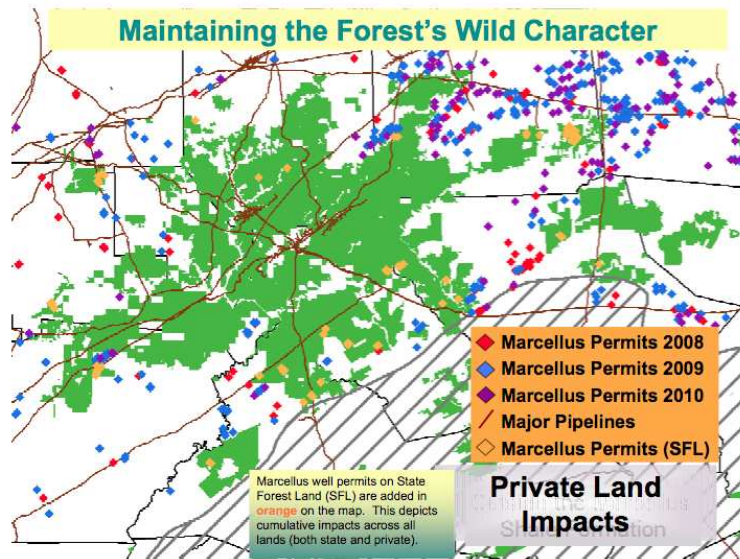


state forestlands across the northern tier of Pennsylvania and Figure 6.3 indicates wells, both state and private, and pipelines developed between 2008 and 2010 on and around the same portion of state forestlands



(DCNR, 2009d)

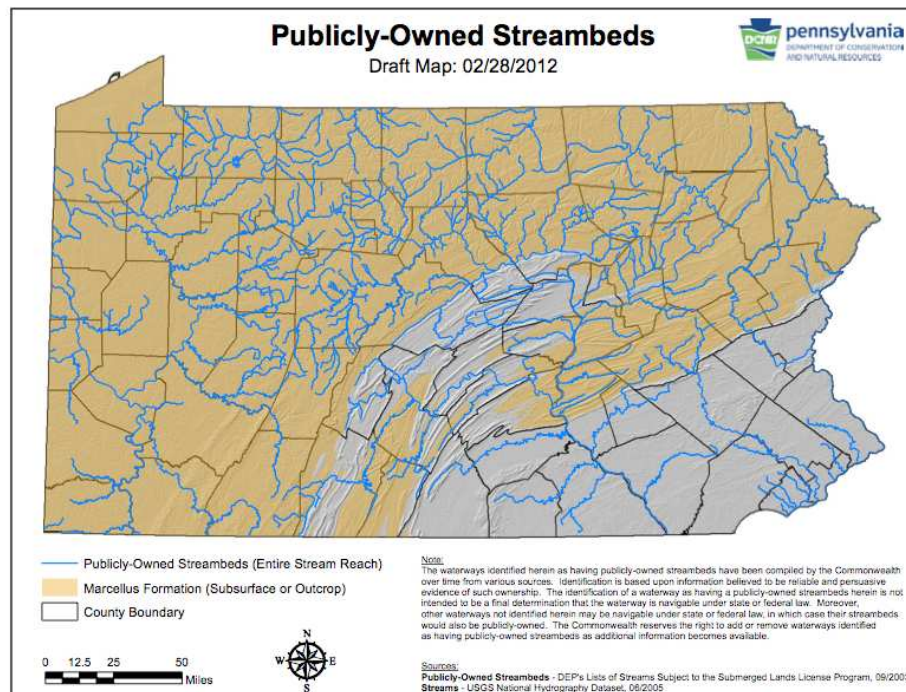
**Figure 6.2 – State Forest Land in North-Central Pennsylvania**



(DCNR, 2009d)

**Figure 6.3 – Pipelines & Both State and Private Wells (2008-2010)**

Waterways throughout Pennsylvania such as streams, creeks, rivers, and lakes are publicly owned when they are considered to be navigable. According to DCNR, the Supreme Courts of the United States and Pennsylvania have, “declared waterways to be navigable when they are or have been used in their ordinary condition as highways for commerce using the customary modes of travel and travel on water available at the time they were used for such purposes” (DCNR, 2009g, p. 1). Prior to modern forms of transportation, Pennsylvania used its waterways as vital highways for commerce, and under some circumstances today these waterways are still used as highways for commerce. Marcellus Shale natural gas underlies many miles of publicly owned waterways throughout Pennsylvania. Figure 6.4 displays the publicly owned waterways throughout the Marcellus Shale natural gas region.



(DCNR, 2009g)

**Figure 6.4 – Publicly Owned Streambeds**

Rights to the gas underlying waterways throughout Pennsylvania can be obtained from leases granted through DCNR, along with submerged lands licenses from the Department of Environmental Protection (DCNR, 2009g).

The Commonwealth of Pennsylvania is no stranger to mining and oil and gas development. Many laws and regulations have been in place affecting these industries for years. However, the development of unconventional Marcellus Shale natural gas is a new and unique process throughout the Commonwealth. Development was allowed to begin without the necessary environmental protections in place to protect the rights to clean air and water and the preservation of the natural environment guaranteed to the citizens of Pennsylvania in their Constitution. It has only been recently that the Pennsylvania Department of Environmental Protection and Pennsylvania Department of Conservation and Natural Resources have set up guidelines for the unconventional drilling, or hydraulic fracturing, of Marcellus Shale natural gas. As indicated throughout this section these guidelines are very broadly based merely making suggestions and recommendations to the natural gas industry on how they should proceed with gas development. The continued rapid increase in land leasing and well development over the last three years throughout the Commonwealth is a clear indicator the healthy state of Pennsylvania's wildlife, waters, and natural resources are taking a back seat to development of Marcellus Shale natural gas.

## **VII. ARGUMENT FOR A NEW ENVIRONMENTAL POLICY PARADIGM**

The Market Paradigm has its foundation in classical economics and is based on maximizing wealth, which relies on the use of cost-benefit analysis (CBA) (Gillroy, Holland, & Campbell-Mohn, 2008). The market use of cost-benefit analysis allows natural resources to have a monetary value placed upon it and to be thought of as a tradable commodity, instead of an entire ecosystem with instrumental value that is essential to basic human functioning. Freeman wrote the primary objective of CBA “is to assess whether the aggregate gains to people made better off by a policy are greater than the aggregate losses to people made worse off by the policy” (as cited in Gillroy et al., 2008, p. 281). The Market Paradigm does not practice the precautionary principle that would allow the use of discretion in decision-making concerning actions or policies that may have a suspected risk of causing harm to humans, animals, plants, or the environment, where scientific knowledge is lacking. The precautionary principle allows anticipatory decision-making, which is decision-making with the ability to foresee and manage events or situations in advance.

Environmental laws and policies in Pennsylvania, as well as the United States, are inadequately based on the principles of the Market Paradigm, along with the use of CBA, and are in need of restructuring with the use of a new paradigm. The type of paradigm needed is one that will take into consideration the instrumental and non-economic values of natural resources, the basic human functioning capabilities of all people that enable people to have a richer quality of life, and one that will incorporate the use of the precautionary principle. Nature and the environment are uncertain, complex entities. Without attempting to incorporate these complexities into environmental policy design,

any new policy will be incapable of adequately protecting and regulating the environment (Gillroy et al., 2008).

A new approach to environmental policy and law is one where an “ideal-regarding approach” versus a “want-regarding approach” is used in policy design and evaluation. An ideal-regarding approach would treat the environment as having “something that is instrumental to intrinsically valuable human purposes”, instead of looking at the environment as merely providing outcomes to satisfy individual preferences or wants (Gillroy et al., 2008, p. 292). One way in achieving this new paradigm is through the use of Martha Nussbaum’s “capabilities approach”. Under the use of the Capabilities Approach, the government has a responsibility to its citizens for the establishment of central human functional capabilities. The possibility for citizens to achieve different things is made possible through the use of these capabilities (Gillroy et al., 2008). Nussbaum (2011) lists ten specific human functional capabilities that must be met in order for a person to, “live a life that is worthy of the dignity of a human being”:

1. *Life*. Being able to live to the end of a human life of normal length; not dying prematurely, or before one’s life is so reduced as to be not worth living.
2. *Bodily health*. Being able to have good health, including reproductive health; to be adequately nourished; to have adequate shelter.
3. *Bodily integrity*. Being able to move freely from place to place; to be secure against violent assault, including sexual assault and domestic violence; having opportunities for sexual satisfaction and for choice in matters of reproduction.
4. *Senses, imagination, and thought*. Being able to use the senses, to imagine, think, and reason-and to do these things in a “truly human” way, a way informed and cultivated by an adequate education, including, but by no means limited to, literacy and basic mathematical and scientific training. Being able to use imagination and thought in connection with experiencing and producing words and events of one’s own choice, religious, literary, musical, and so forth. Being able to use one’s mind in ways protected by guarantees of freedom of expression with respect to

- both political and artistic speech, and freedom of religious exercise. Being able to have pleasurable experience and to avoid nonbeneficial pain.
5. *Emotions*. Being able to have attachments to things and people outside ourselves; to love those who love and care for us, to grieve at their absence; in general, to love, to grieve, to experience longing, gratitude and justified anger. Not having one's emotional development blighted by fear and anxiety. (Supporting this capability means supporting forms of human association that can be shown to be crucial in their development.)
  6. *Practical reason*. Being able to form a conception of the good and to engage in critical reflection about the planning of one's life. (This entails protection for the liberty of conscience and religious observance.)
  7. *Affiliation*. (A) Being able to live with and toward others, to recognize and show concern for other human beings, to engage in various forms of social interaction; to be able to imagine the situation of another. (Protecting this capability means protecting institutions that constitute and nourish such forms of affiliation, and also protecting the freedom of assembly and political speech.) (B) Having the social bases of self-respect and nonhumiliation; being able to be treated as a dignified being whose worth is equal to that of others. This entails provisions of nondiscrimination on the basis of race, sex, sexual orientation, ethnicity, caste, religion, national origin.
  8. *Other species*. Being able to live with concern for and in relation to animals, plants, and the world of nature.
  9. *Play*. Being able to laugh, to play, to enjoy recreational activities.
  10. *Control over one's environment*. (A) *Political*. Being able to participate effectively in political choices that govern one's life; having the right of political participation, protections of free speech and association. (B) *Material*. Being able to hold property (both land and movable goods), and having property rights on an equal basis with others; having the right to seek employment on an equal basis with others; having the freedom from unwarranted search and seizure. In work, being able to work as a human being, exercising practical reason and entering into meaningful relationships of mutual recognition with other workers. (p. 33)

Without being provided threshold levels for all ten of these central capabilities, people are subjected to common forms of deprivation and oppression. If someone should fall below the threshold level of any one of these ten capabilities it is an indication of a “failure of basic justice” (Nussbaum, 2011). An excess of one capability cannot replace a deficit of another capability. An example of this would be if an individual has an emotional connection to a mountain vista that is removed when the area is cleared and a

natural gas well pad is constructed; the monies gained from leasing the land, which affords him improved bodily health, cannot replace the emotional attachment (Gillroy et al., 2008).

The environment is essential in contributing to these central capabilities. Nussbaum looks at the environment as an “independent meta-capability” because of the instrumental value the environment plays in providing basic life support functions and its role in being a critical element leading to a person’s material wellbeing (Gillroy et al., 2008). It is pointed out by Gillroy et al., (2008), that the environment contributes to many of Nussbaum’s central capabilities such as “bodily health,” “other species,” “life,” “senses, imagination, and thought,” and “affiliation” because it creates natural places and certain resources “that are instrumental to material, personal, and social well-being” (p. 297).

Nussbaum’s Capabilities Approach acknowledges when individuals are making decisions they often do not have the full information or knowledge necessary to make fully informed decisions. When information is available, a person may be living in such an oppressive or deprived state, that they are led to make unfavorable decisions (Gillroy et al., 2008). These types of uninformed decisions, or decisions being made due to oppressive and/or deprived states, can be seen across the Marcellus Shale natural gas areas of Pennsylvania. There is an abundant amount of information available concerning Marcellus Shale development; however, one must know where to look for, and have the ability to, access the information. Websites for the Pennsylvania’s DEP and DCNR are full of regulation documents, but often the language in these documents are so technical many people cannot understand their meaning (Carpenter, 2012). A law firm that

represents landowners in oil and gas leasing negotiations reported many landowners sign leases without fully understanding their implications, focusing instead on the up-front payments and promises of future royalties; these landowners become “victims of misinformation” (Clark, 2010). When the Bureau of Forestry began to update their State Forest Resource Management Plan, they did in fact hold nine public meetings across the region (DCNR, 2009b). The locations and times were listed on the DCNR website. However, if the public is not informed to look on the website for this information, or internet services are not available to some citizens, then citizens become unable to effectively participate in political choices that govern their lives. Therefore, “control over one’s environment”, Nussbaum’s tenth human functional capability, is being denied. The economic situation of citizens throughout small-impooverished towns across the Commonwealth is causing some to choose between the environment and what looks like financial security offered from the gas industry. In fact, what is actually happening is what Nussbaum describes as a “failure of basic justice”. Citizens have to give up, or decrease threshold levels of, one or more of their ten central capabilities in order to gain another capability. Their quality of life may be improving in some respects, but in reality they are still unable to “live a life that is worthy of the dignity of a human being” (as cited in Gillroy et al., 2008, p. 293).

The negative impacts from Marcellus Shale natural gas development to wildlife and the environment have the ability to deprive citizens of many of the ten human functional capabilities Nussbaum insists are so critical to a dignified life; in particular, “senses, imagination and thought”, “emotions”, “other species”, and “play”. When natural gas development causes forest fragmentation and new edge, when run off from



well pads and new roads increases stream sedimentation, or when peacefulness in the forest is replaced by the hum of drilling equipment and heavy truck traffic, individuals lose their ability to experience pleasurable experiences and attach positive bonds with nature; they have the potential to lose their freedom to develop positive relationships with animals and plants; and, they risk losing their opportunity to laugh, play, and enjoy recreational activities such as hunting and fishing. When citizens are inadequately informed or are unable to gain access to information due to lack of services or their economic situation, they are being denied their capability of “affiliations” – being able to engage in social interactions - and as stated above, they are denied their capability of “control over one’s environment”.

The use of the Capabilities Approach would not allow the environment to be separated into individual parts to be traded as commodities as the Market Paradigm allows. Existing environmental policy often states “vague or lofty aims” (Gillroy et al., 2008). This vagueness can be seen in the Pennsylvania Department of Conservation and Natural Resources State Forest Resource Management Plan where guidelines for natural gas development are merely suggestions or recommendations, not actual regulations that must be followed. “The Market Paradigm identifies a narrow set of human activities (i.e. consumption and the pursuit of wealth accumulation) as worthy of protection” wrote Gillroy et al., (2008), “it will allow for levels of environmental degradation that surpass what is permissible in a society that seeks to . . . enable people to live diverse and fully dignified lives” (p. 310). The Capabilities Approach would ensure the whole ecological system was considered independently and ensure it supplied the necessary threshold levels of central human functional capabilities, which would also ensure citizens are

involved in the regulatory planning and decision process (Gillroy et al., 2008; Nussbaum, 2011). If one central capability is denied or becomes lacking, such as “control over one’s environment” due to an individual’s lack of the ability to effectively participate in political processes, a negative rippling effect can trickle down precluding the remaining capabilities from being achieved.

## VIII. CONCLUSION

Marcellus Shale natural gas development is booming across the Commonwealth of Pennsylvania. Along with this natural gas boom is the increased degradation of Pennsylvania's 1.4 million acres of state game lands, 2.2 million acres of state forest lands, and 293,000 acres of state park lands, along with many acres of privately owned land. Degradation caused by forest clearing, new forest edge, and stream sedimentation resulting from Marcellus Shale natural gas development is causing negative impacts on the fish, wildlife, and birds that make these areas their permanent homes, along with those that migrate through.

Hunting, fishing, and other recreational activities play an important role in the lives of the citizens of Pennsylvania, as well as thousands of yearly visitors. This is indicated by Pennsylvania being the third most popular destination for people taking day-trips and fifth most popular destination for over-night travelers. In 2010 alone approximately 62% of the 179.2 million people who recreated in Pennsylvania were residents of other states. The 933,208 general hunting licenses sold in 2011 is an indication of the importance hunting plays throughout Pennsylvania (880,818 - residents; 52,390 - non-residents). Fishing also plays an important role as shown by the 806,159 fishing licenses and 455,696 trout/salmon stamps sold in 2011 (general fishing license: 733,559 – residents; 72,600 – non-residents).

Recreational activities also add to the economy of Pennsylvania. In fiscal year 2010, Pennsylvania alone received approximately \$19 million from funds generated through The Federal Aid in Wildlife Restoration Act (aka Pittman-Robertson Act) and The Federal Aid in Sport Fish Restoration Act (Dingell-Johnson Act). In 2011, revenue

generated from fishing licenses added over \$3.6 million to the economy. Survey results from the U.S. Fish and Wildlife Service indicated preliminary expenditures in Pennsylvania from hunting, fishing, and wildlife-watching recreational activities accounted for over \$2.6 million: fishing related - \$484,996; hunting related - \$976,662; and, wildlife-watching related - \$1,225,236.

It is not only these economic benefits that Pennsylvania and its citizens stand to lose from degradation to the environment and losses in biodiversity caused by the improperly regulated Marcellus Shale natural gas development; it is some of the very rights granted to Pennsylvanian citizens by their Constitution – the right to clear air, pure water, and the natural values of the environment. It is also the loss of the quality of life afforded to Pennsylvania’s citizens from the vast wild and natural places, along with the wildlife contained within them, that make up the millions of forested acres across the Commonwealth. Research shows people develop feelings of “place attachment” to particular environmental areas when they associate individual identities and values to those areas. Over time emotional bonds are formed between wildlife, wild natural places, and the people who live amongst, or visit, these areas. Tourism surveys have indicated it is the great opportunities offered by nature that bring recreationist to Pennsylvania. Due to improperly implemented Marcellus Shale natural gas development, these wild natural places across the Commonwealth are threatened; along with the quality of life and emotional bonds so many citizens and visitors to Pennsylvania have formed with the natural areas situated there.

I have argued a new environmental policy paradigm is needed to adequately protect the environment. A new paradigm that will take into consideration the

instrumental and non-economic values of natural resources and provide for the basic human functioning capabilities of all people, including adequate participation in decision-making, which in turn would enable people to have a richer quality of life is what is needed. This can be achieved through the use of Martha Nussbaum's "capabilities approach". Under this new theory of justice, the government has a responsibility to its citizens for the establishments of ten central human functional capabilities, which Nussbaum argues is needed for a person to, "live a life that is worthy of the dignity of a human being" (as cited in Gillroy et al., 2008). The environment plays a critical role in this new approach to policy due to the basic life support functions it provides and its role in being a critical element leading to a person's material wellbeing. Under the current Market Paradigm approach to environmental policy, the environment is separated into individual parts to be traded as commodities. This would not happen under Nussbaum's Capabilities Approach, as it would ensure the whole ecological system was considered independently and ensure it supplied the necessary threshold levels of central human functional capabilities (Gillroy et al., 2008).

Current guidelines developed by Pennsylvania's Department of Conservation and Natural Resources Bureau of Forestry provide many recommendations that could protect vital natural areas and wildlife across Pennsylvania from the detrimental effects of Marcellus Shale natural gas development. Examples of recommendations are: natural gas development should be set back 200 feet of any stream or body of water; fragmentation repair recommendations such as feathering or blending the edges of new edge area caused by forest clearing; or, the creation of brush piles along streams or marshes within woodlands to benefit wildlife species such as bobwhite quail, ruffed grouse, or birds such

as juncos (DCNR, 2009b). However, these recommendations are merely suggestions to the natural gas industry of what they *should* be following, not what they *must* be following during natural gas development. DCNR's (2009b) current guidelines do provide one specific requirement in that "no oil and gas activity of any kind . . . shall be permitted, nor shall they be subject to waivers, on the surface of State Forest Wild or Natural Areas or within State Parks where the Commonwealth owns the oil and gas rights." However, as stated in the Regulations section, this requirement is only applicable on lands where the Commonwealth owns the subsurface mineral rights. Private mineral rights owners are free to lease their rights to the natural gas.

Marcellus Shale natural gas underlies many miles of waterways throughout Pennsylvania. When waterways are considered navigable under rulings from the United States and Pennsylvania Supreme Courts they become publicly owned waterways. Rights to the gas underlying these waterways can be obtained from leases granted through DCNR, along with submerged lands licenses from the Department of Environmental Protection (DCNR, 2009g). Fish and other aquatic wildlife within these waterways are at increased levels of risk due to the potential for toxic chemical migration, sedimentation caused by erosion from the clearing of well pads, roadways, and pipelines, as well as increases in water temperatures due to stream bank clearing. If high-quality cold-water streams are polluted as the result of natural gas development, critical habitat to Pennsylvania's native brook trout will be destroyed and trout populations could be decimated.

The quest for energy is taking place all across the United States and Pennsylvania is no stranger to the oil and gas industry. However, the speed at which Marcellus Shale

unconventional natural gas development is taking place across the Commonwealth, the lack of public participation in decision-making, and the lack of regulations in place to protect the environment, have the potential to cause irreparable damage to the vast natural resources, many miles of waterways, and many species of wildlife that Pennsylvania is known for, and subsequently, human quality of life. The economic gains Pennsylvania receives from hunting, fishing, and other recreational activities are at risk of being lost; as areas that were once pristine wild places filled with only the sounds of nature become littered with fragmented forest, natural gas well pads, pipelines, and excessive noises caused by compressor stations and heavy truck traffic. Recreationist that once sought the wild places across Pennsylvania for peace, solitude, and a bonding with nature will seek out undisturbed areas in other locations and spend their recreational dollars there. The citizens of Pennsylvania should not have to choose between the environment and the economy. However, the economic situation in so many small towns that set atop Marcellus Shale natural gas is causing landowners to do just that, with the environment and a comprehensive approach to human wellbeing taking the back seat to the natural gas industry.

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#### **EDUCATION:**

**Lehigh University**, Bethlehem, Pennsylvania  
College of Arts and Sciences  
January 2013 – Master of Arts, Environmental Policy Design

Thesis: The Effects of Marcellus Shale Natural Gas Development on Hunting, Fishing,  
and Other Recreational Activities Throughout Pennsylvania

Advisor: Dr. David G. Casagrande

**Frostburg State University**, Frostburg, Maryland  
College of Liberal Arts and Sciences  
December 2010 - Cum Laude - Bachelor of Science in Wildlife and Fisheries –  
Biology minor

**Shenandoah University**, Winchester, Virginia  
August 2005 - Associate of Science – Respiratory Therapy

#### **NATIONAL HONOR SOCIETY:**

Pinnacle

#### **SPECIAL HONORS:**

Frostburg State University's 137th Commencement Ceremony, December 2010  
Student speaker representing the College of Liberal Arts and Sciences

#### **PROFESSIONAL ORGANIZATIONS:**

The Wildlife Society (2010 Vice President of the Frostburg State University Student  
Chapter)  
National Audubon Society  
National Wildlife Federation

## **PUBLICATIONS:**

2008. Learning Green, Living Green E=(LG)<sup>2</sup>. *Are FSU students “going green”?*  
Frostburg State University, Frostburg, Maryland.

## **RESEARCH PROJECTS:**

Research Assistant-Lehigh University. January 2012-September 2012

Working under Dr. David G. Casagrande. Flood disaster mitigation. Qualitative data analysis of interviews with community members directly affected by flooding disasters to determine community resilience. NVIVO analysis software used. Arranging and organizing a disaster tour during March 2012 of Midwest communities recovering from natural disasters.

Joint project with Lehigh University, Western Illinois University, and Southern Illinois University.

Research Assistant-Lehigh University. April 2011-September 2012

Working under Dr. Alec M. Bodzin. Climate change. Quantitative data analysis of urban 8<sup>th</sup> grade students' knowledge about climate change science and their understandings about solutions to climate change. Project funded by Toyota USA Foundation WELIM Project.

Joint research project with the College of Education and College of Arts and Sciences.

National Science Foundation REU Internship at Alabama A&M University.

June-July 2010

Independent research study - Invasive Vegetation Effects on Small Mammal Abundance.

Field Technician for Graduate student, Kevin Oxenrider. Spring 2010.

Swamp sparrow mist netting, processing, and banding.

Field Technician for Graduate student, Jimmy Garabedian. Winter 2009-2010.

Habitat preferences of the wintering grassland bird community in The Manassas National Battlefield Park, Manassas, Virginia.

Lab Assistant for Undergraduate student, Melissa Brannon. Fall 2009-2010.

A preliminary analysis of cottontop tamarin communication.

Food Analysis for African Dwarf Frogs (*Hymenochirus boettgeri*). Roxann R. Steelman.  
May 2009.

**VOLUNTEER HISTORY:**

Project Owl-net – annual Saw-whet owl banding  
Maryland Stream Waders Program – Maryland stream monitoring program  
Blandy Experimental Farm – bluebird trail monitoring  
Blue Ridge Wildlife Center – animal rehabilitation caretaker; information table  
National Audubon Society – Christmas bird count  
Shenandoah Audubon – annual birding festival

**EVENTS:**

Project WILD Pennsylvania – Pennsylvania Game Commission – national environmental education program

Frostburg State University hosted the 2010 Wildlife Society Southeastern Conclave

TWS 2009 Southeastern Conclave; Arkansas

**WORK HISTORY:**

Before returning to college full-time, I worked for over 20 years in the fields of health care, health insurance, and law.