

Sexual Predators, Energy Development, and Conservation in Greater Yellowstone

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Abstract: *In the United States, as elsewhere, a growing debate pits national energy policy and homeland security against biological conservation. In rural communities the extraction of fossil fuels is often encouraged because of the employment opportunities it offers, although the concomitant itinerant workforce is often associated with increased wildlife poaching. We explored possible positive and negative factors associated with energy extraction in the Greater Yellowstone Ecosystem (GYE), an area known for its national parks, intact biological diversity, and some of the New World's longest terrestrial migrations. Specifically, we asked whether counties with different economies—recreation (ski), agrarian (ranching or farming), and energy extractive (petroleum)—differed in healthcare (gauged by the abundance of hospital beds) and in the frequency of sexual predators. The absolute and relative frequency of registered sex offenders grew approximately two to three times faster in areas reliant on energy extraction. Healthcare among counties did not differ. The strong conflation of community disarray, as reflected by in-migrant sexual predators, and ecological decay in Greater Yellowstone is consistent with patterns seen in similar systems from Ecuador to northern Canada, where social and environmental disarray exist around energy boomtowns. In our case, that groups (albeit with different aims) mobilized campaigns to help maintain the quality of rural livelihoods by protecting open space is a positive sign that conservation can matter, especially in the face of rampant and poorly executed energy extraction projects. Our findings further suggest that the public and industry need stronger regulatory action to instill greater vigilance when and where social factors and land conversion impact biological systems.*

Keywords: biodiversity, boomtowns, economy, energy, migrants, migration, sexual predators, society, Yellowstone

Depredadores Sexuales, Desarrollo Energético y Conservación en Gran Yellowstone

Resumen: *En los Estados Unidos, como en otras partes, un debate creciente enfrenta a la política energética nacional y la seguridad nacional con la conservación biológica. La extracción de combustibles fósiles en comunidades rurales a menudo es promovida por las oportunidades de empleo que ofrece, aunque la fuerza laboral concomitante a menudo se asocia con incremento en la captura ilegal de vida silvestre. Exploramos los posibles factores positivos y negativos asociados con la extracción de energía en el Ecosistema Gran Yellowstone (EGY), un área conocida por sus parques nacionales, diversidad biológica intacta y algunas de las migraciones terrestres más largas en el Nuevo Mundo. Específicamente, preguntamos si condados con diferentes economías—recreación (esquí), agraria (agricultura o ganadería) y extracción de energía (petróleo)—difieren en asistencia médica (medida por la abundancia de camas de hospital) y en la frecuencia de depredadores sexuales. La frecuencia absoluta y relativa de transgresores sexuales creció aproximadamente dos o tres veces más rápido en áreas dependientes de la extracción de energía. La atención médica entre condados no difirió. La mezcla de desorden comunitario, reflejado por depredadores sexuales inmigrantes, y la descomposición ecológica en Gran Yellowstone es consistente con patrones observados en sistemas similares*

desde Ecuador hasta el norte de Canadá, donde existe desorden social y ambiental alrededor de las ciudades que prosperan por la extracción de energía. En nuestro caso, los grupos (aunque con diferentes propósitos) que promovieron campañas para ayudar a mantener la calidad de vida rural mediante la protección de espacios abiertos son una buena señal de que la conservación puede tener importancia, especialmente ante proyectos de extracción de energía descontrolados y ejecutados deficientemente. Nuestros resultados adicionalmente sugieren que el público y la industria requieren mayor acción reguladora para inculcar mayor vigilancia donde y cuando los factores sociales y la conversión de tierras impactan a los sistemas biológicos.

Palabras Clave: biodiversidad, ciudades prósperas, depredadores sexuales, economía, energía, migrantes migración, sociedad, Yellowstone

Introduction

As we humans seek to improve our lifestyles, the use of fossil fuels will continue to increase. The imbalance between resource extraction and conservation is especially evident in areas where energy reserves are abundant and wildlife and their habitats are unprotected, a situation that persists in large and sparsely populated areas of Central Asia, Sub-Saharan Africa, and the New World. Although simultaneous extraction of natural resources and protection of wildlife with minimal environmental degradation may be conceptually possible, case studies illustrate that extraction results in loss of ecological characteristics that link quality of life to open space and biodiversity.

In the last few decades, it has become clear that development of wide-scale energy projects takes social and biological tolls and has resulted in conservationists, social advocates, and regulatory bodies—including law enforcement—banding together to slow the erosion of traditional rural lifestyles. For instance, boomtowns associated with energy extraction (but not recreation) in the western United States experience social upheaval manifested by increases in use of illicit drugs, domestic violence, and other crimes (Power 1996), poaching of wildlife (Berger & Daneke 1988), and irreversible habitat alterations (Gude et al. 2007; Aldridge et al. 2008). These sorts of problems often arise because of differences between traditional residents and the incoming workforce. Traditional residents have been grounded in their local settings; thus, their lifestyles and valuation of wildlife are often very different from those of the incoming workforce (Berger & Daneke 1988; Fuller 2007, 2008).

That biological diversity often decreases with the advent of extraction-based boomtowns and their associated social disruption has been established widely across broad scales from the Amazon to Alaska (Canaday & Rivadeneira 2001; Mittermeier et al. 2003; Suárez et al. 2009). It is not surprising that boomtowns bust and that a generally predictable pathway is followed. Rodrigues et al. (2009) showed that as resources become depleted economies decline, and the land with its coincident biological wealth is left in disrepair, as is community spirit. In short, imprudent alterations of landscapes conflate the biological-social milieu that belies the quality of life for

local residents. The coincident disarray (Fig. 1) is mediated through a series of progressively corrupting events, at least with respect to energy boomtowns in the western United States.

Our goals here were twofold. First, we explored the growing debate between national energy policy and biological conservation, where, in North America, for example, much concern has focused on wildlife-rich regions from Alaska to Canada and through the Rocky Mountain Cordillera (Hummel & Ray 2008; Cherney & Clark 2009). Specifically, we used two societal markers and three types of rural communities to identify positive and negative elements associated with changing human economies. Second, we examined how the intersection of social dysfunction and potential biological impoverishment that arises as a consequence of energy extraction is promulgating unlikely social alliances.

Methods

The Greater Yellowstone Ecosystem

The Greater Yellowstone Ecosystem (GYE) is often referred to as the largest intact ecosystem in Earth's

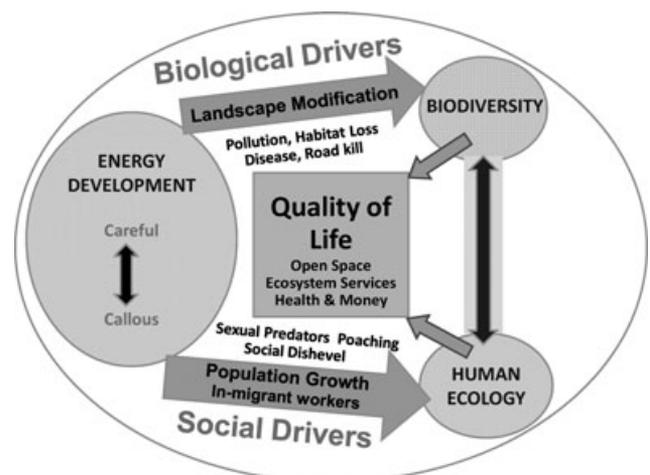


Figure 1. Summary of major pathways reflecting biological and social drivers in energy boomtowns that ultimately affect ecosystem services and the quality of human life.

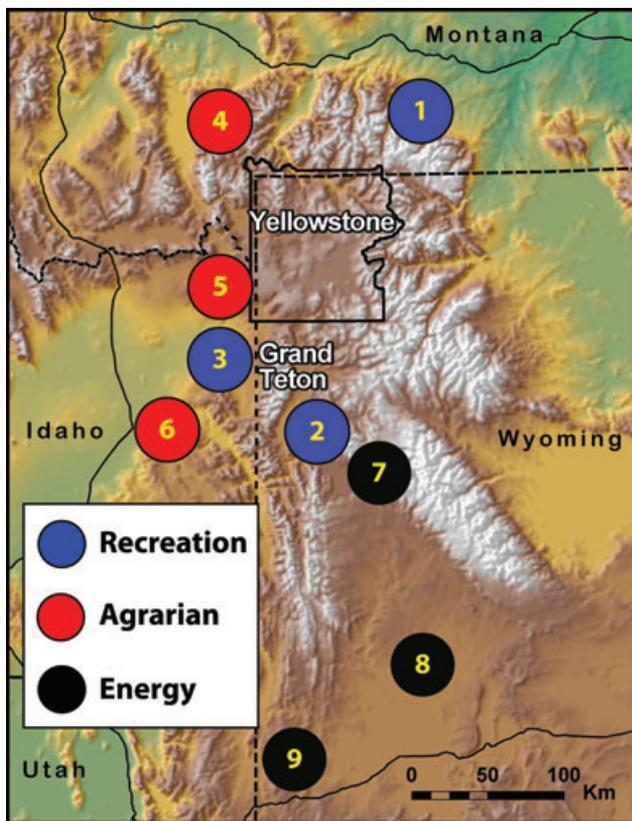


Figure 2. Locations of nine counties categorized as recreation, agrarian, and energy. Numbers are counties and their names are provided in Table 1.

temperate zone, and it is best known for its geothermal resources, as well as bears, wolves, migrations, and predator-prey interactions (Smith et al. 2003; Pyare et al. 2004). Within its 60,000 km² are two national parks (Grand Teton and Yellowstone), four national wildlife refuges, and seven national forests (Fig. 2). Beyond the national parks, and at the GYE's southern tier, is the Upper Green River Basin. The area's populations of large mammals are diverse and attain Serengeti-like congregations (Berger 2003), with 100,000 wintering ungulates (e.g., mule deer [*Odocoileus hemionus*], pronghorn [*Antilocapra americana*], elk [*Cervus elaphus*], moose [*Alces alces*], and bighorn sheep [*Ovis canadensis*]).

Beyond the species themselves, important ecological processes dominate, including long-distance migrations of elk, mule deer, moose, and pronghorn (Berger 2004; Sawyer et al. 2005); the latter's migration extends to 550 km through the Upper Green River Basin (Berger et al. 2006). The migrations, however, are challenged by habitat losses in part due to land conversion, natural and human bottlenecks, fencing, and energy development (Beckmann et al. 2008). Truck traffic in energy-extraction areas has increased fivefold since 2000 (Jacquet 2009), and, notably, in one devastating collision, more than 20 pronghorn were killed by a single vehicle. Farther south,

violations associated with poaching have increased at higher rates in energy boomtowns than in communities associated with either agriculture or tourism (Berger & Daneke 1988). Hence, we assessed whether societal benefits and ills might be similarly related to different types of boomtowns in the GYE and asked what this can reveal about how the mix of social and biological factors might affect conservation.

Among the notable types of communities in the Yellowstone ecosystem, two are predominant: wealthy and recreationally based (e.g., Jackson Hole region), and resource-extraction based (e.g., Sublette County and others). The Jackson Hole region of Teton County, Wyoming, is scenic and rich in wildlife, and its economy is dominated by the skiing and tourism industry. The area is considered a magnet for celebrities and political leaders, and in 2005 Teton County had the highest mean per capita standard of living in the United States. Adjacent to Teton County is Sublette County, where the Jonah Field—one of the most productive energy-extraction sites in the lower United States—is located. The field holds an estimated 190–280 billion m³ of natural gas (Beckmann et al. 2008; Kiesecker et al. 2009). The population of the county has exploded with a large influx of workers associated with the Jonah Field (Fuller 2008; Jacquet 2009).

Data Collation, Assessment, and Limitations

We characterized nine counties in and adjacent to the Greater Yellowstone area by their principal economic drivers: energy extraction, agriculture, or recreation (e.g., skiing, wildlife observations, hiking, camping; Table 1; Fig. 2). We then used three counties within each group for analyses.

To gauge changes in community composition and available services, we used two metrics: (1) number of registered sexual offenders (RSOs; convicted felons that are

Table 1. Principal economy and regional hospitals in nine counties of the Greater Yellowstone Ecosystem, U.S.A.

Principal economy	County ^a	Hospital ^b
Recreation	1. Carbon, MT	Beartooth Hospital*
Recreation	2. Teton, WY	St. John's Medical*
Recreation	3. Teton, ID	Teton alley Hospital**
Agrarian	4. Madison, MT	Ruby Vally, Madison Valley*
Agrarian	5. Fremont, ID	none*
Agrarian	6. Jefferson, ID	none*
Energy	7. Sublette, WY	none*
Energy	8. Sweetwater, WY	Memorial Hospital*
Energy	9. Unita, WY	Evanston Regional†

^aNumber for each county reflects location in Fig. 2 (MT, Montana; WY, Wyoming; ID, Idaho).

^bAdministrators at each hospital were spoken with; final confirmations as follows: *, Regional Commissioner's office; **, election office; †, county economists office.

required by law to register their presence to state legal authorities when they change residences) and (2) number of hospital beds per capita as a crude measure of the quality of local healthcare (Table 1). Data on the annual frequency of RSOs are available online for only the most recent 6 months. We requested data from the nine county attorney offices, working first through the attorney generals' office of each state to acquire the confidential but censored data (no specific names or details of offences provided). We calculated the cumulative total of offenders per year for each county. Our analyses relied on standard regression and analysis of variance techniques, although when data did not fit assumptions of normality we used distribution-free statistics as noted in the following section. The data on RSOs and hospital beds spanned all but 2 years from 1997–2008. We explored the relationship between expansion of human population and growth in exploitable gas, contrasting new home construction with the volume of gas produced (Montgomery 2008; Wyoming Office of the Assessor 2008).

Because we have lived and conducted field research in these communities for the past 8 years, we also have attended countless community and town-hall meetings. Additionally, we have met and interacted with officials from ranching, social service, hunting, and business sectors and with environmental and other advocacy groups and elected officials at town, county, and state levels. These interactions offer the basis from which we examined the formation of alliances among diverse players to address questions about the melding of life styles, social dysfunction, and wildlife conservation.

Results

Important differences among communities reliant on the natural environment in the GYE existed (Fig. 3). Both the absolute and relative frequency of RSOs grew about two to three times faster in counties dependent on oil and gas extraction relative to those dependent on recreation or agriculture. Since 1997, when the RSO registry was federally mandated, sexual predators were more than 300% more prevalent by 2008, and they increased more rapidly in counties dominated by oil and gas extraction (Kruskall-Wallis test, $\chi^2 = 35.55$, $p < 0.0001$; Fig. 3). Dunn's post hoc pair-wise contrasts revealed sources of between-treatment variation as follows: energy versus ski ($Q = 5.54$; $p < 0.002$), energy versus agrarian ($Q = 2.32$; $p < 0.10$), and ski versus agrarian ($Q = 2.83$, $p < 0.02$).

By contrast, the frequency of hospital beds—an indicator of availability of immediate healthcare—did not differ among counties (KWT, $\chi^2 = 3.15$, $p = 0.21$), which indicates communities did not invest disproportionately in our metric of healthcare, irrespective of their economic base. Increases in gas production were significantly asso-

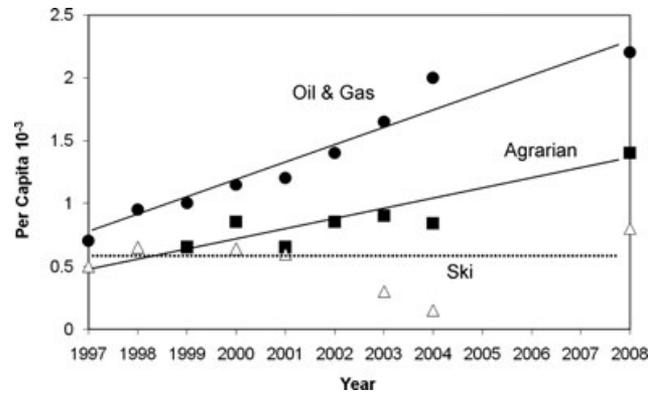


Figure 3. Mean per capita changes (per 1000 residents) in frequency of registered sexual offenders for nine counties in or adjacent to the Greater Yellowstone Ecosystem (Kruskall-Wallis test, $\chi^2 = 35.55$, $p < 0.0001$). Statistically significant regressions are solid lines (oil and gas, $Y = 0.1212x - 241.01$; $r^2 = 0.953$, $p < 0.001$; agrarian, $Y = 0.0769x - 153.09$; $r^2 = 0.823$, $p < 0.005$; ski [dashed line], $Y = 0.0104x - 20.33$; $r^2 = 0.02$, $p < 0.668$).

ciated with new housing units in Sublette County (Fig. 4), and the number of gas wells per year was, likewise, correlated with the number of completed new housing units per year from 2001–2005 ($Y = 608.02 [\ln X] - 3465.9$; $r^2 = 0.919$; $n = 5$, Sublette County Planning & Zoning, unpublished data).

In sum, we found no difference in the per capita number of hospital beds across counties. On the other hand, the relative frequency of convicted sexual predators increased significantly in areas associated with energy development (Fig. 3).

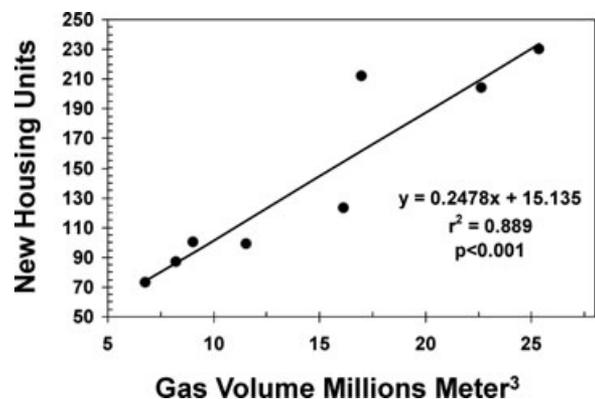


Figure 4. Number of new housing units as a function of gas exploited in Sublette County, Wyoming, from 2000–2007 ($y = 0.2478x + 15.13$; $r^2 = 0.89$; $p < 0.001$).

Discussion

Yellowstone and Grand Teton parks are visited by more than five million visitors annually. The GYE receives even more visitors because many recreate in areas beyond the parks, which comprise <15% of the GYE. Although growth in economic activity may benefit local counties, communities obviously differed, and some were more attractive than others. The evidence that social ills accrue in energy boomtowns has been well chronicled (Tetley 2005), primarily through analyses of changes within individual communities over time (Wilkinson et al. 1982; Summers & Branch 1984; Jacquet 2009). Our results add to this knowledge in three ways.

First, our research design incorporated community dynamics across time and space. We found that change in social ills was not necessarily a product of demographic growth over time, but rather a product of type of in-migrant worker, as least as suggested by contrasts among energy-, agrarian-, and recreation-based communities within the same landscape.

Second, whereas the GYE has been known for its native carnivores (wolves and bears), which have attracted massive numbers of tourists, our findings underscore an increase in sexual predators, who are attracted to energy boomtowns (Fig. 3) due to high rates of employment and high salaries. This situation is not dissimilar to that reported elsewhere in the Rocky Mountains 30 years earlier, when conservationists became alarmed at higher levels of poaching in energy boomtowns relative to agrarian and recreation-based communities (Berger & Daneke 1988).

Third, an associated measure—hospital beds—did not differ in relative frequency among the three sorts of communities (Table 1; Fig. 2). Although industry can and should tout their important contributions—such as greater tax bases, the building of auditoriums, and improvements for education—our metric of local health care was not among the contributions. Furthermore, our evidence brings forth additional information on the social pathway(s) by which energy development helps drive human ecology and contributes to the quality of life in affected areas (Fig. 1). Although conservationists must work hand-in-hand with the public and agencies to promote change and to educate citizens, it is clear that industry or other economic drivers must bear significant costs to help facilitate the positive elements of society such as health care, prudent land use planning, wildlife protection, and law enforcement. Nevertheless, a high-variance economy often occurs at local scales where towns boom and bust (Power 1996). Such a pattern may then lead to long-term social ills because boom environments over the long term remain unattractive to not only human immigrants, but also to biological diversity. In the western United States migration routes are being lost (Berger 2004) and diseases such as West Nile virus are

increasing; the latter diminishes harvestable resources such as Sage Grouse (*Centrocercus urophasianus*) (Nauget et al. 2005). In the Amazon, boomtowns that result from extraction of natural resources lose appeal once resources are depleted (Rodrigues et al. 2009).

The connection among landscape-level alterations, social disarray, and the unraveling of biodiversity is well substantiated (see Fig. 1). Nevertheless, the conflation of social and biological drivers at the intersection of energy boomtowns has received far less attention (Berger & Daneke 1988). Among the gas fields at the southern tier of the Greater Yellowstone region (Fig. 2), social forces conspired to enhance land protection for harvestable wildlife, such as elk and mule deer, and attendant biodiversity. In 2009 President Obama signed the Wyoming Range Legacy Act, which protects more than 1.2 million acres, an action that arose from the unified efforts of public and private entities, such as Wyoming Wildlife Federation, Wyoming Backcountry Horsemen of America, Bowhunters of Wyoming, Wyoming Outfitters and Guides Association, Sublette County Outfitters & Guide Association, Wyoming Game Wardens Association, Wyoming Biologists' Association, Hoback Peak Outfitters, Citizens Protecting the Wyoming Range, and Jackson Hole Chamber of Commerce. Although these are not environmental organizations involved in advocacy for social causes or for biodiversity, valuable conservation lessons have emerged.

A de facto alliance resulted between groups promoting protection for outdoor recreation and wildlife and those concerned with the perception of social injustices due to rapid changes in traditional lifestyles. Sexual predators in addition to a suite of other and rapid social changes have impacted life quality for many long-time residents in these typical small communities. Science also played a role; empirical results were presented locally throughout Wyoming (Berger et al. 2006). As a direct consequence of gas and oil extraction, Wyoming's governor, Dave Freudenthal, successfully put forth legislation to protect wildlife migrations. In 2007 it was unanimously approved by the Western Governors Association.

That groups with different aims mobilized campaigns to maintain the quality of rural livelihoods by protecting open space should offer hope globally to those under threat from rampant and poorly planned energy production facilities. Although Greater Yellowstone offers the world much in terms of large landscapes, stunning scenery, functional predator-prey relationships, and biological diversity, the poorly planned gas fields of the Upper Green River Basin also proffer elements of a seedier nature. These elements involve social dishevelment, including a rise in the frequency of sexual predators, increasing crime, pollution, and habitat conversion (Fig. 1). Still, given society's overarching preference to maintain

comfortable lifestyles that are based on extractable energy and a predilection to maintain wildlife, enhanced funding by municipalities, industry, or other sources will be required both for public safety and to prevent erosion of wildlife populations.

As conservation biologists, we hope that other parts of North America and the world can learn from the less-than-prudent planning that occurred in the southern GYE. If the unfortunate model that we have described becomes more widespread, both human and biological systems lose.

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