Tools of the Trade: How Protected Area Managers Can Protect Our Night Sky

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Introduction

Night is a vital part of our environment, worthy of preservation just as any other natural or cultural resource. It involves both the night around us and the view we have of the stars and the universe in which we live.

Today, two-thirds of the USA's population live where they no longer have naked-eye visibility of the Milky Way (Cinzano 2001). The current generations are the first in history to grow up without the awe-inspiring view of a canopy of stars above their heads. Over the millennia, this view inspired art, music, poetry, folklore, science, technology, and so much of our culture. The grandeur of the stars challenges us to explore and invites us to ponder our place in the universe. It is an essential part of our very nature as well as our culture. As important in our history as it is integral to our future, it is our heritage.

Sky glow from low-quality outdoor lighting robs us of that heritage. Fortunately, there are straightforward, workable solutions. Improved practices will allow a functional, comfortable, and beautiful night-time environment, one friendly to humans, wildlife, plants, and the night sky. To preserve and protect our night-time environment, we must educate people about the value of high-quality outdoor lighting.

Building Relationships with Nearby Communities

As leaders on environmental issues, protected area managers must help raise awareness and protect endangered resources. Similar to watersheds or air quality, our night sky is affected by practices both inside and outside of protected areas. To address external threats to these resources, managers must work collaboratively with nearby communities.

The benefits of better lighting practices offer communities practical reasons to support improved lighting. Resultant economic savings and improved property values, for example, augment the motivation for and support the goal of resource protection. Communities care about this issue and addressing it means identifying community values, priorities, and shared interests, thus laying essential groundwork for building relationships.

Educating a community and developing a consensus on outdoor lighting builds many educated allies. Ordinances promote good lighting and good business, limit obtrusive or trespass lighting and sky glow, address community issues, and help everyone see better. Hundreds of communities and ten states (Arizona, California, Colorado, Connecticut, Maryland, Maine, New Mexico, Texas, Virginia, and Wyoming) have adopted lighting regulations, and many more are considering them. (Three countries, Australia, Chile, and the Czech Republic, have national-level lighting regulations.)

- Better-quality lighting provides a *better night-time ambiance* that improves property values and quality of life and encourages night-time activity, business, and a sense of community.

- Correcting low-quality lighting leads to *energy and economic savings* for businesses and the community.
- The *improved visibility* of better lighting design promotes safety, security, and the utility of night-time activities.

Correcting low-quality lighting is clearly a win–win proposition and a non-partisan issue. When protected area managers work with communities on these issues it helps build the relationships so critical to long-lasting resource protection.

Good Lighting has Great Value

Before lighting, one must ask: Why is the light needed? Is it needed? What is the task? Driving a vehicle, walking up to a building, playing basketball, pumping gas, recognizing faces, and enjoying an evening stroll are very different tasks with different lighting needs. Once one understands the task, use the right amount of light, in the right place, at the right time, with *energy-efficient sources.*

Use levels of lighting that are rational for the task, not too much or too little. The Illuminating Engineering Society of North America publishes recommended practices for lighting design, including appropriate lighting levels for specific tasks. Problems arise when installations use 5, 10, and even 100 times the recommended levels. That not only creates waste, but poor visibility and insecure situations.

Appropriate lighting levels take into account lighting levels in the surrounding environment. While our eyes can see over a wide range of lighting levels, they need time to adapt to changing levels. The adaptation time is longer when going from bright to dark (than vice versa) and increases as the eye ages (International Dark-Sky Association {IDA} information sheet nos. 136 and 156). Good lighting design provides reasonable transitions between the brightest and darkest areas, allowing our eyes to adapt so we see better in all areas. The solution is not to raise lighting levels in all darker areas but to use rational levels in brighter areas. Rational lighting levels improve visibility. Too much light wastes energy and can hinder visibility.

Direct the light only where it is needed. Light directed upward may light birds and clouds, but is that a useful purpose? It creates much of our urban sky glow, the bane of astronomers and anyone wishing to enjoy the beauty of the night sky. Shield lights to prevent direct uplight (wasted energy) and minimize glare. We should see the effect of the light, not the source.

Unshielded luminaires create glare and highlight the source rather than the area to be illuminated. Glare is the sensation produced by luminance within the visual field that is sufficiently greater than the luminance to which the eyes are adapted to cause annoyance, discomfort, or loss of visual performance and visibility—or simply, "blinding light." The elderly are particularly susceptible to glare. Glare hinders visibility in the illuminated zone so it is difficult to see obstacles or recognize faces, for example. Glare prevents our eyes from adapting to see into nearby areas, thus creating insecure situations. Criminals use glare to their advantage, hiding in shadows before using the bright light to act quickly. Shielded luminaires with rational lighting levels allow us to see better by reducing glare, thus improving visibility and promoting safety and security. Good outdoor lighting design should minimize glare.

Good lighting design guides us by helping us identify where to go and what to avoid. Too much low-quality lighting creates clutter and confusion, ruining the night-time ambience rather than adding to its value.

Light that shines where it is not wanted or needed is "obtrusive" or "trespass" light. Street lighting, for example, should light the streets, not the interior of houses or neighboring ecosystems. Light trespass occurs whenever the light shines beyond the intended target and onto adjacent properties. It can be annoying; it wastes energy; it can adversely affect neighboring ecosystems.

Use light only when it is needed. Turn lights off when activity ceases, or change lighting levels if the activity changes after a certain time. Effective technologies include motion sensors, dimmers, and multi-level lighting. When the light is not being used, it is being

wasted.

Wasted light wastes energy and money. The operating cost of a light fixture over its lifetime is significant, especially when compared with the initial cost of the lighting fixture or lamp. In the USA, the waste adds up to more than $1 billion a year, or an annual waste of at least 6 million tons of coal or 23 million barrels of oil (IDA information sheet no. 26). Wasted energy uses limited, precious resources and produces unnecessary environmental pollution.

Light pollution is a form of pollution that costs us more to continue than to stop. Premcor oil refinery in Texas found that shielding and lowering wattages in 20,000 unshielded fixtures saves more than $350,000 annually (at the low, bulk energy rates of 3.3 cents per kilowatt hour that they receive) and improves the visibility in the facility while meeting Occupational Safety and Health Administration (OSHA) standards (Taylor 2003). Shielding the lights improved visibility by minimizing glare. Shields redirect more of the lamp source's light in the direction needed; they put more light where it is needed so one can reduce the lamp wattage and save energy while maintaining the illumination levels that existed before the shielding.

In the last few years, the diversity of well-shielded lighting fixtures and energy-efficient technologies has improved dramatically. A helpful sampling is illustrated in the IDA's "Good lighting fixtures and where to get them" web-based tables. In May 2003, 70 manufacturers and well over 150 fixtures were represented in 21 categories. Many architectural styles are available, including period lighting now available in better-shielded versions that mimic historical styles but offer better light control and less glare.

Unshielded, historical fixtures (e.g. globes, post-tops) are beautiful in the daytime, but usually become "glare bombs" at night. The new, shielded versions are one alternative. Another is to use lower lighting levels in these historical fixtures while providing the majority of illumination from supplemental, energy-efficient, shielded luminaires in unobtrusive locations. The pedestrian enjoys a soft, comfortable ambience from the historical fixtures plus good visibility from the shielded fixtures.

Low-quality lighting has crept up on us, but there are straightforward technological and social solutions that offer significant cost savings. Shielded luminaires can improve efficiency and offer better visibility. Lighting practices are improving. Good design requires asking, "Do we need the light, and why?" Then we must use rational lighting levels, direct the light only where needed, use the light only when needed, and use energy-efficient sources. With better lighting we improve visibility, promote safety and security, conserve energy, and preserve our night-time environment.

Photobiology: Health and Wildlife

Life on our planet evolved with a daily, monthly, and seasonal cycle. We need periods of both light and dark. These cycles strongly affect patterns of behavior and changing them can affect wildlife behavior and survival in numerous ways. The alteration or extension of the length of the day can diminish habitat function, such as providing shelter or food. Light alters predation habits and effectiveness. It affects reproductive patterns and natural diurnal rhythms. Natural, predictable light regulates natural processes (Falzon and Bonnici 2001).

Circadian rhythm is a powerful one for all wildlife and for humans. For example, during dark hours, many organisms produce the hormone melatonin. Melatonin has been linked to the immune response. Exposure to small amounts of light suppresses melatonin production. Light at the wrong time can stimulate jet lag and sleep disorders. Our day/night cycle is ingrained, and changing it stresses our systems (Pauley 2001).

As with noise pollution, obtrusive light also can cause stress. Our systems need a break. To maintain health, balance, and the ecological integrity of systems, we need both adequate, natural light during the day and darkness at night.

Raising Awareness

Incorporated in 1988, the IDA is a non-profit educational and research organization that addresses an environmental issue: the preservation and protection of the night-time environment and our heritage of dark skies. Spanning 70 countries and every state in the USA, its diverse membership includes organizations, city officials, lighting professionals, architects, professional and amateur astronomers, environmentalists, educators, and concerned members of the public. Their combined expertise has created reliable information on the diverse topics related to light pollution. The IDA offers educational activities and outreach tools designed to raise awareness and promote solutions. As leaders in environmental awareness, protected area managers can help educate everyone about the value of our night-time environment and the benefits of improving our outdoor lighting. Everyone benefits.

With growing awareness, many people are contributing to solutions. Lighting professionals are rewriting recommended practices to address related items such as glare, maximum recommended illumination levels, and the effects of obtrusive light and sky glow. Manufacturers have responded to the demand for better-quality shielded fixtures. Communities around the world are implementing ordinances requiring environmentally responsible and economically sensible lighting practices. After all, good lighting has great value.

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