

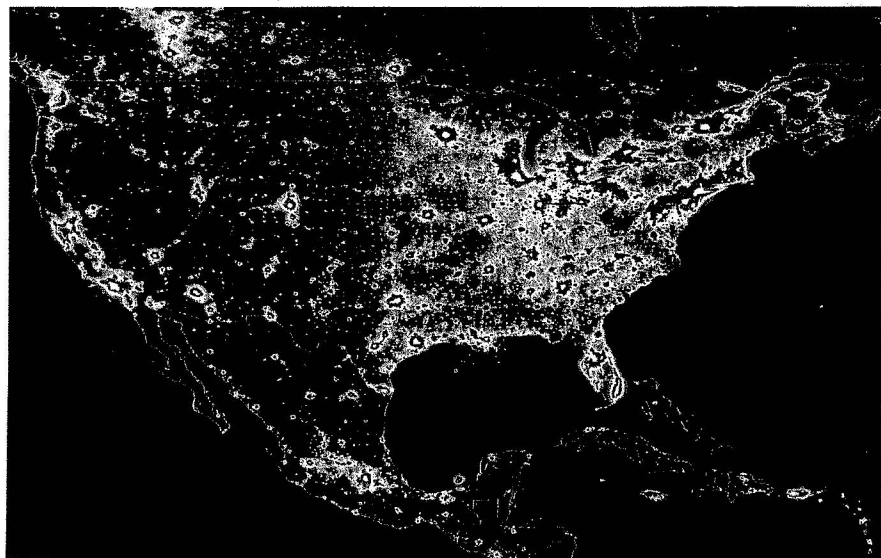
FINTestimony

From: Jim Crisafulli [JCrifafu@dbedt.hawaii.gov]
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Jim Crisafulli, Director
Office of Aerospace Development
Strategic Industries Division/DBEDT
State Office Tower, Suite 503
235 S. Beretania Street
Honolulu, HI 96813
Tel: (808) 586-2388
Fax: (808) 586-2536
Cell: 808-383-9811
E.mail: jcrisafu@dbedt.hawaii.gov
Web: <http://aerospacehawaii.info/>

Can we win the war against light pollution?

The night sky is getting brighter. Here's how we can reverse the trend. by Michael E. Bakich



Division of Science & Technology, Office of Management & Enterprise Services

Observers, astrophotographers, and nature-lovers all have a common enemy: light pollution. This insidious problem, caused by excess nighttime lighting, is growing worldwide. Satellite images show few regions of our planet's nightside are truly dark. It's possible, in fact, that the Moon is the only object young people in large cities will ever see. Indeed, the dark night sky is an endangered natural resource.

Nobody denies that some outdoor lighting is necessary for people's safety

Michael E. Bakich is a senior editor of Astronomy.

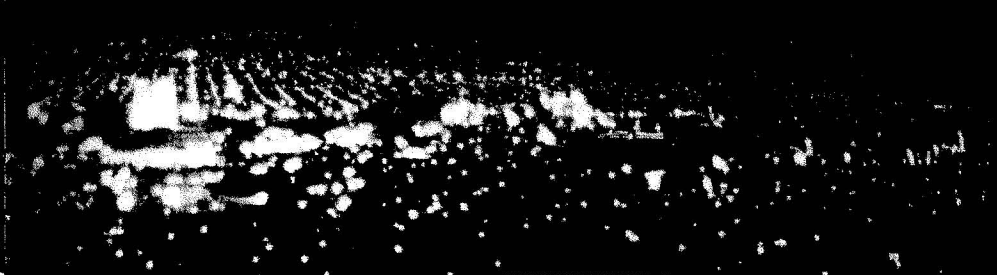
and security. Other lighting, such as that used for advertising, may not be necessary, but it's a consequence of living in our world today. If those lights are designed and maintained correctly, they can be a benefit without taking away from the night sky's beauty.

Defining the problem

Outdoor light pollution manifests itself in three ways: light trespass, glare, and clutter. Light trespass occurs when unwanted external light enters your property. It can ruin an imaging session or cause sleep deprivation if bright light enters through a bedroom window.

This color-coded map of light pollution across the United States shows the darkest areas as black. These areas generally are remote. Gray and mauve regions are ideal hunting grounds for pristine skies. Often, these areas are rural and are not accessible by road. Green sections have acceptable dark-sky conditions. If you don't have access to any of the black areas (as will be the case in many of the northeastern states), go for the green.

Glare results from high contrast between lit and unlit areas. Although it affects amateur astronomers, it's most often a problem for drivers. Bright streetlights, advertising signs, and poorly placed lights used by businesses are the primary causes of glare.



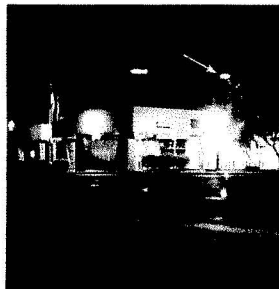
Bad lighting in El Paso, Texas — and many other cities — has multiplied in recent years. If not for the mountains in the background, these lights might have gone on farther. Michael E. Bakich

Clutter refers to badly designed or excessive light groups that generate confusion or cause safety issues. This generally affects automobile drivers.

The light stops here

The best outdoor lighting falls under the classification "full-cutoff." Full-cutoff fixtures do not allow light to escape above 90°, which marks the edge of the lamp's shade. Such fixtures distribute light in a directed pattern and provide equivalent ground lighting with less power. The first full-cutoff light fixture was General Electric's M100, introduced in 1959.

Many states mandate full-cutoff lights for building or highway construction. Today's full-cutoff fixtures generally employ high-pressure sodium lamps. Introduced in 1970, they are the dominant streetlights in the United States. The main characteristic is their orange-yellow



With all the bad lighting in this photograph, it's tough to pick out the one light (arrow) that conforms to the full-cutoff standard. Michael E. Bakich



Earth at night gets less dark every year. As this image shows, the worst offenders are the United States and Europe. Data courtesy Marc Imhoff of NASA GSFC and Christopher Elvidge of NOAA NGDC. Image by Craig Mayhew and Robert Simmon, NASA GSFC.

glow. They use far less energy than mercury-vapor or metal-halide lamps.

Government action?

In August 2008, the International Dark-Sky Association (IDA) worked with Congress on a bipartisan letter in support of light pollution research and education. Signed by 11 U.S. Congressional repre-

sentatives, it asked the U.S. Environmental Protection Agency (EPA) to take four steps against light pollution:

- 1) Codify a formal definition for "light pollution" that captures the detrimental effects that result from unchecked nighttime illumination.
- 2) Incorporate consideration of the environmental, safety, and health effects

Confronting light pollution: National Dark Sky Week

Each year, the International Dark-Sky Association (IDA) chooses one week during which they hope everyone in the United States helps to temporarily reduce light pollution. It's called **National Dark-Sky Week** (NDSW). The IDA encourages us all to turn off unnecessary lights so we can realize the wonder that our universe holds. If everyone participates, NDSW will inspire us to use better lighting systems. NDSW was founded not only to reduce light pollution, but also to help people connect with the night sky.

NDSW usually occurs in April during the week of New Moon. This year, New Moon occurs April 25. So, across the United States,

amateur astronomers and concerned citizens will participate in NDSW each night between April 20 and April 26 from 10 p.m. to 12 a.m. EDT.

Besides raising awareness of the problem, NDSW's goals are to reduce light pollution temporarily, allowing us to see the night sky in greater detail; encourage people to use better light fixtures; and give everyone a greater appreciation for astronomy, thus recruiting others to help reclaim our dark skies lost because of poor lighting. If you want to get involved with NDSW, visit star parties and observatories that are hosting local events. —M. E. B.



Forget about astronomy for a moment. These streetlights produce so much glare that safety is the issue for drivers and pedestrians. *Michael E. Baah*

of current levels of light pollution into EPA research programs.

3) Expand the discussion of well-designed (and thus energy efficient) outdoor lighting in [the federal efficiency program] Energy Star publications and standards.

4) Support education about light pollution in the agency's education, outreach, and grant programs.

"Encouraging the EPA to address light pollution is a great first step at federal protection of our night skies," says Christian K. Monrad, president of the IDA Board of Directors. "We [IDA] estimate that there are approximately 2,500 outdoor lighting codes in the U.S. alone; some of them very well-written and others that are not. Having federal research and recognition of light pollution would

assist states and municipalities in having a solid baseline for future codes and revisions to current ones."

Moving to protect dark skies, Energy Star included specifications for full shielding of solid-state streetlights in its proposed criteria for 2009. If passed, the requirements will impact the design of all future LED (light-emitting diode) streetlights. These criteria are the result of input gathered at a series of Department of Energy (DOE) sponsored workshops.

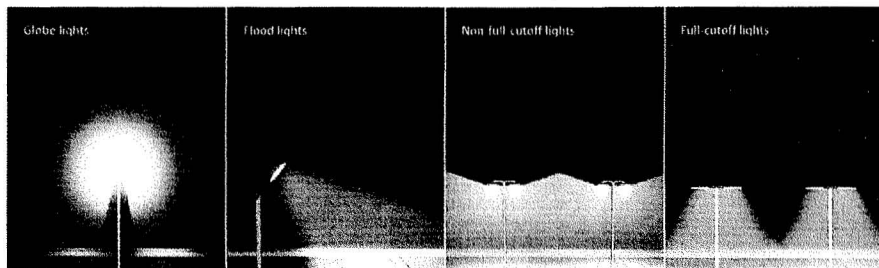
Energy Star is America's most widely recognized energy efficiency program. It began in 1992 as a cooperative effort between the DOE and the EPA. Energy Star's primary goals are to save money and reduce environmental impact through energy-efficient products and practices. Visit the Energy Star web site at

<http://www.energystar.gov> for more information about Energy Star's goals.

What can you do?

I talked to a leading vendor of approved light fixtures, Anthony Arrigo, president of Starry Night Lights. He's come up with 10 ways you can help in the fight against light pollution. They're listed here with only slight modifications:

- 1) Light only what needs lighting. This sounds simple, but it typically gets overlooked. Ask yourself, "Does this even require lighting?"
- 2) Light only when you need it to be lit. OK, so you've determined that it really requires light. Does it need to be lit at all times? If you go out to your shed only once a week, does it really need to be lit dusk to dawn every night?



Progressively better outdoor lights (left to right) reduce both glare and sky glow. The best lights employ full-cutoff shades, which direct light below the horizontal, sending the least amount of light into the sky. *Astronomer: Peter Neffly*

Fleeing light pollution: Arizona Sky Village

Many folks who seek a remedy for light pollution have taken up residence in premier observing locations. The country's most ambitious astronomical development is Arizona Sky Village (ASV).

Located in the foothills of the Chiricahua Mountains, ASV sits at the mouth of Cave Creek Canyon in Portal, Arizona. Four-acre lots of deed-restricted property and Interval Ownership Haciendas (time shares) occupy this expanse of high desert. Several dozen homes already populate the development.

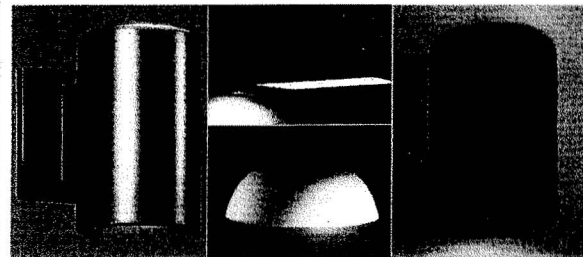
Arizona Sky Village is the vision of its first residents, Gene Turner and Jack Newton. Turner combines a lifelong fascination with astronomy with a career in real estate development to manage the project's nuts and bolts. Newton, a leading astromager for decades, is a household name among amateur astronomers. He's producing his best images ever from his observatory on the ASV site and also has discovered several supernovae.

ASV's sky is only a couple tenths of a magnitude brighter than the most remote locations on Earth. Southeastern Arizona enjoys a dry, yet moderate climate characterized by insignificant snow and tolerable summer heat. Its latitude is southerly enough to elude cold fronts and far enough west to remain dry.

Developments such as Arizona Sky Village represent the future of dark-sky astronomy. Filling desirable locations with amateur astronomers can only help to keep light pollution at bay. — *M. E. B.*



This light fixture, installed when a restaurant opened, is an example of extreme light pollution because of the amount of light it emits horizontally. People with no interest in astronomy complained about it from the first night it went into operation. *Michael E. Baah*



This selection of IDA-approved lighting is part of the line offered by Starry Night Lights. As these examples show, full-cutoff lights don't have to be ugly to be effective. *Images courtesy starnightlights.com*

3) Use only as much light as is required. Don't always install the highest available wattage. If you're not performing surgery on your patio, there's no need for operating room illumination levels.

4) Use only full-cutoff light fixtures. Full-cutoff fixtures shine light onto the ground and prevent light from crossing property lines or up into the night sky.

5) Shield existing fixtures. If you're not quite ready to install new, full-cutoff fixtures, light shades are available for many fixtures. Shades will convert the fixtures into night-sky friendly fixtures for a minimal cost.

6) Install motion sensors. Such devices will turn your lights on automatically

whenever there is activity outside your home or business. Taking this step typically reduces your use of electricity for lighting by more than 90 percent. Such a saving easily pays for the cost of the sensor and its installation.

7) Install reflectors. Many times, you can use reflectors to outline a driveway instead of a string of lights. Reflectors are cheaper to purchase, cost nothing to run, and are unaffected by power outages.

8) Get used to the dark. Our eyes are quite good at night. If you take the trash out at night, do you need to turn your outdoor lights on? Chances are good that you'll be able to find the trash can and make your way to the curb.

9) Educate those around you about light pollution. This includes your family, friends, neighbors, and elected officials. With just a little bit of thought and effort, light pollution is one type of environmental problem that can be cleaned up without any side effects.

10) Show your support for current efforts. Help promote groups such as the International Dark-Sky Association and manufacturers who produce approved fixtures. If you blog, write about light pollution. Don't just gripe! Mention success stories whenever you can.

Taking a proactive approach to light pollution ensures that future nights will be safe, healthy, and dark. ♪



UNIVERSITY OF HAWAII SYSTEM

Legislative Testimony

Testimony Presented Before the
House Committee on Finance
April 7, 2009, at 3:30 p.m.

by

Virginia S. Hinshaw, Chancellor
and

Richard Wainscoat

Astronomer, Institute for Astronomy, University of Hawai'i at Mānoa
and

President, Commission 50, International Astronomical Union

SB 536 SD1 HD1 RELATING TO STARLIGHT RESERVE

Chair Oshiro, Vice-chair Lee, and members of the committee: My name is Richard Wainscoat and I am here today to submit this testimony in my capacity as an Astronomer at the University of Hawai'i Institute for Astronomy, and as President of Commission 50 of the International Astronomical Union, for the protection of existing and potential observatory sites.

The University of Hawai'i at Mānoa strongly supports this bill and recommends that it be passed.

Hawai'i has two of the best astronomical observatory sites in the world. Mauna Kea Observatory on the Island of Hawai'i is arguably the best observing site on Earth. Haleakalā Observatory on Maui is among the best observing sites in the Northern hemisphere. Mauna Kea is threatened by light pollution. Haleakalā already suffers from significant light pollution that comes both from Maui County and from O'ahu.

Much of the populated area of the Earth suffers from unnecessary light pollution. Light pollution is adverse effects of man-made lighting including sky glow, energy waste, glare, and environmental harm. Much of it is unnecessary, and results from careless and wasteful use of light at night. The Island of Hawai'i has had a lighting ordinance for many years, and it has protected the dark night sky over Mauna Kea. However, continued population growth and the associated growth in lighting is threatening the dark night sky over Mauna Kea, and will require more careful choice of lighting in the future. Maui County enacted a new lighting ordinance in 2008 that will help to reduce light pollution over Haleakalā. However, Maui's lighting ordinance will do nothing to reduce the light from O'ahu that is affecting Haleakalā. Kaua'i does not have a lighting ordinance, but already has some of the best lighting in Hawai'i because it has many endangered birds. All streetlights on Kaua'i are fully shielded, and emit no light above the horizontal plane; unshielded lights cause confusion to birds (possibly leading to death).

Light can travel for over 200 miles through the atmosphere (light from Honolulu can be seen from Mauna Kea). Therefore, preservation of the night sky is a statewide issue.

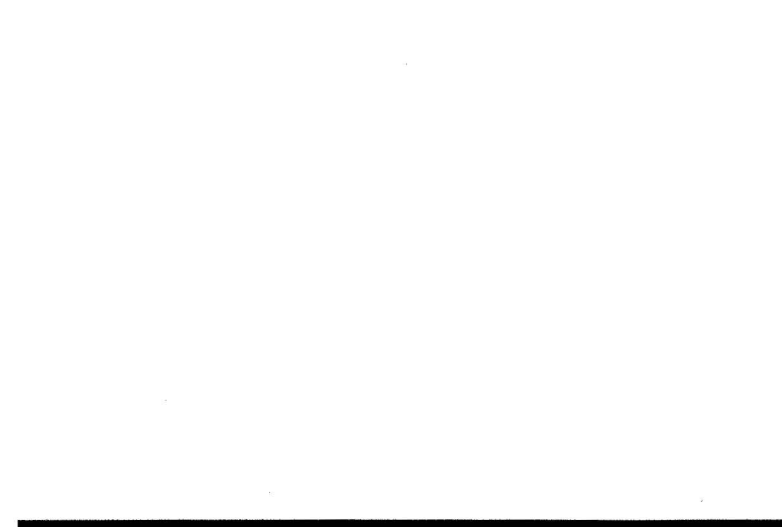
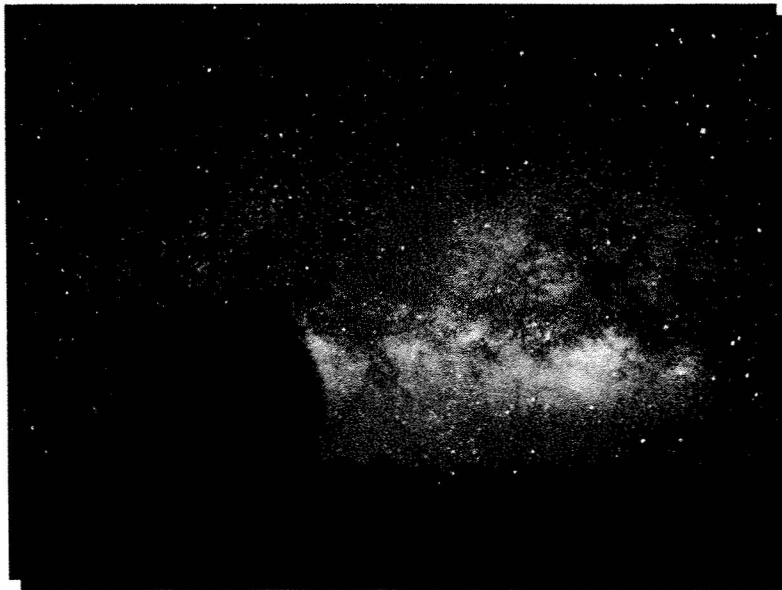
Sky glow is the aspect of light pollution that most affects astronomy. Air molecules and dust scatter artificial light into the telescopes. Every 10% brighter that artificial light makes the sky from its natural level makes the effective size of a telescope 10% smaller. The following series of photographs, using the same exposure, shows the difference in sky brightness and star visibility between Mauna Kea, Kailua (O'ahu), and Honolulu. On O'ahu, the sky at Sandy Beach, where we take our undergraduate astronomy students to view the night sky is about four times brighter than on the Big Island. The Milky Way is barely visible from Sandy Beach. Much of the light that is being sent upwards into the sky is wasted, and therefore corresponds to wasted energy. In Hawai'i, approximately \$10 million is wasted each year by poor lighting.

The "Starlight Reserve" concept is being developed in cooperation with the United Nations Educational, Scientific and Cultural Organization (UNESCO) to address the loss of the ability to view the night sky that is happening across the Earth. Over 99% of the visitors to Hawai'i come from places with significant light pollution. Much of the continental United States has a serious light pollution problem. The night sky is relatively unpolluted on all of the major Hawaiian Islands except O'ahu, and even on O'ahu, the dark night sky could be recovered by more careful use of light at night. The State Department of Transportation is already improving lighting on highways by using fully shielded light fixtures in new installations and when replacing existing fixtures.

The work of the advisory committee that will be created by this legislation will have tremendous benefits to Hawai'i that extend far beyond protection of astronomy. These include:

1. Energy savings, by reducing or eliminating wasteful use of light at night;
2. Improved road safety by reduction of glare from roadway lighting;
3. Benefits to animals, including endangered birds that become confused by artificial lights at night, and endangered turtles, that use stars to guide them to the water after hatching or nesting, and mistake artificial lights for stars;
4. Preservation and recovery of the ability of Hawai'i's residents and visitors to view the beauty of the night sky; and
5. Benefits to human health. Light at night disrupts the human circadian rhythm, and has been linked to breast and prostate cancer. Because of this link, the World Health Organization has listed shift work as a probable carcinogen.

Thank you for the opportunity to present this testimony.



Photographs of the night sky seen from Mauna Kea (top), Kailua, O'ahu (middle), and Honolulu (bottom), using exactly the same exposure time. Notice the dramatic differences in sky brightness, and how many more stars are visible from Mauna Kea than from O'ahu.



SB 536, SD 1, HD 1, RELATING TO STARLIGHT RESERVE
House Committee on Finance

April 7, 2009

3:30 p.m.

Room: 308

The Office of Hawaiian Affairs (OHA) supports S.B. 536, S.D. 1, H.D. 1, which requires the State Department of Business, Economic Development, and Tourism (DBEDT) to develop a statewide starlight reserve strategy, including an intelligent statewide lighting law, to preserve the quality of the night sky and its associated cultural, scientific, astronomical, natural, and landscape-related values. The bill also calls for the establishment of a temporary advisory committee to assist DBEDT in the creation of the starlight reserve strategy. OHA would have a representative on this advisory committee.

The night sky is an important instrument for Native Hawaiians. In Hawaiian culture, stars, planets and the moon predict weather conditions, foretell events in the form of hoʻyailona, or omens, and serve as a calendar and land markers. The night sky instructs farmers what to plant, fishers what to catch and open-ocean navigators where to go. As Native Hawaiians continue to reconnect and revive ancient traditions, the integrity of the night sky becomes more and more significant.

Light pollution, particularly in heavily developed areas, has limited the ability of Native Hawaiians to learn about the night sky and use it as their ancestors once did. Moreover, artificial light represents a major threat to some seabirds. For example, bright lights such as street lights can blind and disorient Newell's Shearwater fledglings, resulting in many of these young birds being hit by cars or preyed on by cats and dogs.

The statewide starlight reserve strategy contemplated in this measure would help address some these issues by protecting the night sky as an important cultural landscape for Native Hawaiians and ensuring the safety of some of our native seabirds.

OHA urges the Committees to PASS SB 536, S.D. 1, H.D. 1.
Thank you for the opportunity to testify.



SIERRA CLUB HAWAII CHAPTER

P.O. Box 2577, Honolulu, HI 96803
808.538.6616 / hawaii.chapter@sierraclub.org

HOUSE COMMITTEE ON FINANCE

April 7, 2009, 3:30 P.M.
(Testimony is 1 page long)

TESTIMONY IN SUPPORT OF SB 536, SD1, HD1

Aloha Chair Oshiro and Members of the Committee:

The Sierra Club, Hawaii Chapter, with over 5500 dues paying members statewide, supports SB 536, SD1, HD1, formulating a starlight reserve strategy for the State of Hawaii.

While this measure appears geared toward minimizing light pollution that adversely impacts stargazing, reducing unnecessary light pollution has an environmental benefit. Artificial lighting can adversely impact the nesting and feeding behaviors of birds and marine life.

Every year, thousands of baby birds (fledglings) leave their nests for their first flight to the ocean. Many of them are disoriented by bright night-time coastal lights, often scenic ocean spotlights in residential coastal communities but also airport and facility lights. After flying to exhaustion (or collision) and falling to the ground, exhausted fledglings are extremely susceptible to predation.

Adult seabirds, including the endangered Hawaiian petrel (*Pterodroma sandwichensis*) and the threatened Newell's shearwater (*Puffinus auricularis newelli*), also suffer the negative impacts of artificial night lighting. The wedge-tailed shearwater (*Puffinus pacificus*), while not yet listed as threatened or endangered, is protected under the Migratory Bird Treaty Act and adversely impacted by artificial night lighting. These protected seabirds are found in many areas throughout the State and transit coastal areas that are fully developed. In addition to protecting Hawaii's native and endangered species, residents and visitors alike share a great appreciation of dark Hawaiian skies for stargazing—and romantic walks along the moonlit beach.

Please forward SB 536, SD1, HD1.

Thank you for the opportunity to testify.





PLEASE DISTRIBUTE ACCORDINGLY- MAHALO!!

TESTIMONY IN STRONG SUPPORT OF SENATE BILL 536

Members of the Committee:

I apologize for not being able to testify in person, but wanted my views heard. I strongly support Senate Bill 536. Shorefront lighting is being used all over Maui to “enhance” our views of the ocean at night- something the moonlight does all on its own, naturally. Instead, the feeling of being in a sports arena completely ruins the ambience. There is nothing more beautiful than a star-filled sky, but the stars don’t stand a chance against these powerful lights. It must be so frustrating for the scientists atop Haleakala who have to filter out the sky glow as best they can to obtain meaningful data. Safety should not be an excuse for using these lights. Believe it or not, humans have excellent night vision, which can’t be put to the test with such a constant barrage of lights.

Besides the fact that these strong lights are very irritating, they attract helpless moths and insects and navigating seabirds, and they disrupt the nocturnal rhythms of the nearshore environment. But the impacts of coastal lighting on nesting sea turtles and their hatchlings are my main concerns. As you may know, we are lucky enough to have two species of sea turtles which nest on Maui, the green (*Chelonia mydas*) and the hawksbill (*Eretmochelys imbricata*), known as *honu* and *‘ea* in Hawaiian. The *honu* is listed on the Endangered Species List as “Threatened”, and the *‘ea* is listed as “Critically Endangered”. Sea turtles normally return to nest where they themselves were born 20-40+ years before. What was Maui like 40 years ago? Much darker with less human disturbance, that’s obvious to everyone. It is possible these turtles that are returning to nest are unable to find a suitable dark, quiet beach. They may be forced to lay nests in inadequate locations that aren’t conducive for successful hatchling development or lead to the disorientation of their hatchlings by coastal lighting. Or even worse, nesting females may be forced to abandon the search and lay their eggs in the ocean... Obviously the eggs won’t survive, and the long migrations are a wasted opportunity to continue their species. There were ~2,000 sea turtle hatchlings born on Maui in 2008 and, if they survive, they will be returning in 20-40 years. What is Maui going to be like then?? Please think of the present and the future, and take into consideration all creatures that will benefit from this measure. Please pass it!

Mahalo for taking the time to read my testimony.

Cheryl King
Hawai‘i Wildlife Fund
Hawksbill Recovery Project, Maui Research Coordinator

FINTestimony

From: mailinglist@capitol.hawaii.gov
Sent: Monday, April 06, 2009 11:40 AM
To: FINTestimony
Cc: refrey2001@yahoo.com
Subject: Testimony for SB536 on 4/7/2009 3:30:00 PM

Testimony for FIN 4/7/2009 3:30:00 PM SB536

Conference room: 308
Testifier position: support
Testifier will be present: Yes
Submitted by: Richard E. Frey
Organization: Individual
Address:
Phone:
E-mail: refrey2001@yahoo.com
Submitted on: 4/6/2009

Comments:

Please support this bill to start protecting our ability to see the wonders of the night sky.

Chair Oshiro, Vice Chair Lee, Committee Members

Mahalo for the opportunity to testify on Senate Bill 536 SD1 HD1 which sets the stage to develop a statewide lighting law, one of the first states in the country to enact such a law, to preserve the quality of the night sky for current and future generations in addition to saving valuable resources and money.

My name is John Gallagher and I am testifying as a private citizen of the Great State of Hawaii and as the Night Sky Coordinator of the Hawaiian Astronomical Society, a non-profit organization founded in 1949 dedicated to amateur astronomy and sharing of the night sky with the public and our schools.

I am testifying in **strong** support of this bill because:

- a. Long range cost savings to the State and Counties.
- b. Potential to increase tourism as a premier location for viewing the night sky.
- c. Preserving the night sky for scientific and astronomical studies and observations,
- d. Protect our endangered wildlife needing a dark environment.
- e. Protect the long range health of our citizens as more evidence is being discovered on the effects of light pollution on the human body.
- f. Provide for cultural activities associated with dark skies.
- g. Open the window to wonders of the night sky for many adults and children who have never experienced the majestic wonders and imagination that a truly dark sky can instill.

Mahalo for allowing me to testify.