Hiding in Plain Light: Marine Light Pollution, the Maritime Industry, and the Case for IMO Action

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Executive Summary

Artificial light at night poses significant and often underestimated threats to marine ecosystems worldwide. Marine light pollution disrupts biological rhythms, navigation, and reproductive cycles among numerous species, thereby contributing to biodiversity loss and ecosystem degradation. Yet, the maritime industry, being one of the leading sources of artificial light across the ocean, remains largely unregulated in this context. Vessels at sea emit intense and persistent artificial light through deck lighting, operational lights, and general illumination. Marine light pollution impacts some of the most ecologically sensitive and least protected environments on the planet. Technical solutions such as LED retrofitting, directional shielding, and operational lighting protocols are available and can substantially reduce vessel light emissions without compromising safety or operational efficiency. However, in the absence of a binding international regulatory framework, the widespread adoption of these measures has been limited. This paper argues that the International Maritime Organization, through the International Convention for the Prevention of Pollution from Ships, is the appropriate and essential authority to address this regulatory deficiency and proposes a systematic pathway to achieve this objective.

I. Introduction To Marine Light Pollution

The natural cycle of day and night is fundamental for regulating biological processes in nearly all living organisms on Earth. Sunlight and moonlight promote growth and provide direction, while darkness provides safety and allows creatures to hunt and feed. Artificial light at night (ALAN) refers to artificial illumination that modifies natural nighttime light regimes, thereby disrupting essential biological processes.[1] Although ALAN is commonly associated with urban and developed areas, its impacts on the marine environment are equally damaging. Many marine organisms rely on subtle natural cues from the diurnal cycle to regulate migration, reproduction, predator avoidance, orientation, and feeding behaviors.[2] Despite concerns for the marine environment, few regulations or laws address marine light pollution, and existing policies often specifically exempt major contributors of ALAN such as shipping and vessel lights.[3] This paper examines the unique challenges and consequences of artificial light pollution in the marine environment from the international maritime industry, underscores the urgent need for improved oversight and solutions, and outlines steps to regulate marine light pollution from the shipping and fishing industries.

[1] Thomas W. Davies, et al., "The Nature, Extent, and Ecological Implications of Marine Light Pollution," *Frontiers in Ecology and the Environment 12*, no. 6 (2014): 347–48, https://doi.org/10.1890/130281.

[2] Laura F. B. Marangoni et al., "Impacts of Artificial Light at Night in Marine Ecosystems-A Review," *Global Change Biology 28*, no. 18 (2022): 5347-48, https://doi.org/10.1111/gcb.16264.

[3] Republic of Croatia, Zakon o zaštiti od svjetlosnog onečišćenja [Act on Protection from Light Pollution], NN 14/2019, art. 3(1)–(2) (2019); République française, *Arrêté du 27 décembre 2018 relatif à la prévention, à la réduction et à la limitation des nuisances lumineuses*, JORF no. 0300 (December 28, 2018), arts. 1, 3(V), Légifrance, https://www.legifrance.gouv.fr/loda/id/JORFTEXT00003786x4346/. Croatia expressly exempts maritime-traffic/navigation-safety signalization and, with a limited exception, lighting of sea ports and inland-waterway ports. France also contains maritime-safety and port-related exceptions; Marangoni et al., "Impacts of Artificial Light at Night in Marine Ecosystems," 5359-60.

II. The Harms of Marine Light Pollution

Marine light pollution is costly not only to the environment but also on the wallets of the very industry from which it originates. This section outlines some of the many ways marine light pollution affects the shores, shallows, deep waters, and even the air of the marine environment. Discussion here is limited to impacts linked to the maritime industry.[4] Following the overview of environmental harms is a short discussion of the financial impacts of marine light pollution.

1. Effects on the Marine Environment

Light pollution is detrimental in any environment; however, its effects in marine settings are particularly complex, impacting coastal, shallow, and deep-water habitats. Large coastal and shipping infrastructure along the shore emits constant, intense light visible for miles.[5] This persistent illumination can disorient marine species, disrupt essential biological processes, and significantly damage shoreline marine ecosystems. Marine creatures that come ashore, such as crustaceans and turtles, are especially vulnerable. While some turtle species exhibit tolerance to light, others, including the critically endangered leatherback, are highly sensitive. When turtles come ashore to nest, even minimal artificial light can cause nest abandonment. Hatchlings are even more at risk as they rely on natural moonlight to navigate to the ocean.[6] Bright shoreline lighting from coastal infrastructure can mislead hatchlings away from the water, increasing mortality rates.[7]

[4] While there are many shoreline contributions to marine light pollution, such as ports and the growing global urban sprawl. Maritime Industry and the impacts discussed in this paper have been limited to vessels and rights under the jurisdiction of the International Maritime Organization.

[5] Sara E. Pratt, "Bathed in a Sea of Artificial Light," *NASA Earth Observatory*, March 2, 2022, https://science.nasa.gov/earth/earth-observatory/bathed-in-a-sea-of-artificial-light-149518/.

[6] Sam Zlotnik, "Leatherback Sea Turtles Struggle to Find the Ocean on Moonless Nights," *Society for Integrative and Comparative Biology*, accessed August 30, 2026, https://sicb.org/sicb-news/leatherback-sea-turtles-struggle-to-find-the-ocean-on-moonless-nights/.

[7] Marangoni et al., "Impacts of Artificial Light at Night in Marine Ecosystems," 5351-52.

Light pollution extends beyond the shoreline. Illumination from cruise ships, vessels, and offshore infrastructure permeates marine environments, affecting both shallow and deep-sea habitats. In shallow waters, artificial light disrupts predator-prey interactions among corals, plankton, squid, whales, and other species.[8] Artificial marine light pollution interferes with camouflage by altering how predators perceive prey coloration and visibility. These changes can modify population structures, reduce color diversity, and influence evolutionary pressures on species that rely on camouflage.[9] Additionally, diurnal corals exposed to artificial light at night expand their tentacles, a daytime behavior triggered at the wrong time. This behavior is energetically costly and may result in a negative energy budget, as ALAN does not provide sufficient light for photosynthesis.[10] By artificially brightening nighttime conditions, ALAN advances the perceived timing of these triggers. Corals on neighboring lit and unlit reefs may spawn on different nights, reducing fertilization success and genetic exchange between reef systems.[11]

Further offshore where nights are typically completely dark, artificial light has a more pronounced impact. Light from ships and offshore infrastructure can penetrate deeply, with detectable light reaching depths greater than 40 meters in some regions depending on water clarity, seasonal optical conditions, and wavelength composition.[12] Artificial lighting alters fish foraging behavior, disrupts trophic interactions, reduces reproductive success in clownfish, changes coral physiology,

[8] Marangoni et al., 5347, 5356-57.

[9] Emma Moyse et al., "Artificial Light at Night Alters Predation on Colour-Polymorphic Camouflaged Prey," *Basic and Applied Ecology 73* (2023): 88, 91-92, https://doi.org/10.1016/j.baae.2023.11.002.

[10] M. L. Mardones et al., "Artificial Light at Night (ALAN) Disrupts Behavioural Patterns of Reef Corals," *Marine Pollution Bulletin 194* (2023): 115365, 6-7, https://doi.org/10.1016/j.marpolbul.2023.115365.

[11] Thomas W. Davies et al., "Global Disruption of Coral Broadcast Spawning Associated with Artificial Light at Night," *Nature Communications 14* (2023): 2511, 1-3, https://doi.org/10.1038/s41467-023-38070-y.

[12] Marangoni et al., 5356-57.; T. J. Smyth et al., "A Global Atlas of Artificial Light at Night under the Sea," *Elementa: Science of the Anthropocene* 9, no. 1 (2021): 00049, 5-6, 10, https://doi.org/10.1525/elementa.2021.00049.

and shifts species recruitment across marine ecosystems.[13] It also interferes with diel vertical migration in zooplankton species such as Calanus, which rely on natural lunar illumination to coordinate movement through the water column, a process critical to marine food webs and carbon cycling.[14] [15] The sensitivity of marine organisms to nighttime illumination is so extreme that artificial lighting during Arctic polar night conditions has disrupted the behavior of both fish and zooplankton at depths reaching two hundred meters.[16]

Marine light pollution not only affects the shore and sea but also projects upward into the sky, causing significant mortality in seabirds. Coastal artificial lighting can severely disrupt seabird navigation and increase mortality.[17] Illumination from the maritime industry, tourist developments, and industrial facilities attract and disorient young seabirds as they attempt to fly from nesting colonies to the ocean. In some cases, illuminated coastal urban areas act as barriers between inland colonies and the sea and some birds are attracted to lights after reaching open water.[18]

Marine light pollution currently affects nearly two million square kilometers of ocean.[19] As shipping traffic increases and more artificial lights are introduced into marine environments, the

[13] Marangoni et al., 5355-57.

[14] Thomas W. Davies and Tim Smyth, "Why Artificial Light at Night Should Be a Focus for Global Change Research in the 21st Century," *Global Change Biology 24*, no. 3 (2018): 876-77, https://doi.org/10.1111/gcb.13927.

[15] Marangoni et al., 5357.

[16] Marangoni et al., 5357.

[17] Airam Rodriguez et al., "Fatal Attraction of Short-Tailed Shearwaters to Artificial Lights," *PLOS ONE 9*, no. 10 (2014): e110114, 1-2, https://doi.org/10.1371/journal.pone.0110114.

[18] Airam Rodriguez, Beneharo Rodriguez, and Juan J. Negro, "GPS Tracking for Mapping Seabird Mortality Induced by Light Pollution," *Scientific Reports 5* (2015): 10670, 2-4, https://doi.org/10.1038/srep10670.

[19] Smyth et al., "Global Atlas of Artificial Light at Night under the Sea," 5.

effects of oceanic light pollution are expected to intensify.[20] Disruption of the natural light cycle has far-reaching consequences, including altered behavior and survival of marine organisms.

2. Financial Waste

In addition to extensive environmental impacts, light pollution also imposes considerable financial costs. Researchers estimate that at least thirty percent of all artificial light is wasted, with light emitted into the sky, dispersed into surrounding waters, or otherwise used without serving a practical function.[21] Maritime energy studies indicate that light systems can account for a significant portion of a ship's on-board electrical load, although precise calculations are challenging due to variations in vessel types and operating conditions.[22] Consequently, the expense of powering unnecessary or poorly directed light could accumulate hundreds of thousands of dollars per vessel.[23] Not only is excessive lighting a waste of resources with substantial environmental implications, but it is completely avoidable.

III. Why the International Maritime Industry?

Although marine light pollution has far-reaching and severe environmental consequences, regulation of artificial light in marine environments remains limited.[24] Currently, there is no comprehensive global treaty that establishes enforceable standards for artificial light from vessels,

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[20] Anthony Sardain, Erik Sardain, and Brian Leung, "Global Forecasts of Shipping Traffic and Biological Invasions to 2050," *Nature Sustainability 2* (2019): 274–82, 274, 276, https://doi.org/10.1038/s41893-019-0245-y. The authors project global maritime traffic to increase substantially by 2050.

[21] DarkSky International, "Light Pollution Wastes Energy and Money and Damages the Climate," updated October 17, 2023, https://darksky.org/resources/what-is-light-pollution/effects/energy-climate/. DarkSky estimates that at least 30 percent of outdoor lighting in the United States is wasted, primarily from unshielded lighting.

[22] Yiğit, Kökkülünk, and Savaş, "Comparative Analysis of Ship Lighting Systems," 190–91. The study reports 214,868 kWh/year of lighting-system electricity use for one bulk carrier before an LED retrofit, but it does not report lighting as a percentage of the vessel's total onboard electrical load.

[23] *See* Yiğit, Kökkülünk, and Savaş, "Comparative Analysis of Ship Lighting Systems."

[24] Marangoni et al., 5359-60.

offshore infrastructure or coastal developments, despite increasing scientific evidence of significant ecological harm.[25] As a result, regulation primarily relies on domestic laws resulting in inconsistent protections and substantial regulatory carveouts for economically significant industries such as shipping and vessel operations across international jurisdictions.

A limited number of countries have initiated efforts to address marine light pollution within their territorial waters and coastal zones, although their approaches differ significantly.[26] Some countries utilize broad environmental protection statutes that indirectly address artificial light through general pollution control or biodiversity conservation measures; others have enacted legislation specifically targeting light pollution. However, these laws often focus exclusively on terrestrial sources such as urban development, commercial signage, or residential lighting, with minimal attention to marine ecosystems or offshore activities.[27] Only a few countries have established legal frameworks that are considered relatively robust for addressing marine or coastal light pollution. These laws typically acknowledge the ecological significance of maintaining darkness along coastlines and within sensitive marine areas. Nevertheless, even the most advanced regulatory regimes frequently include substantial exemptions for shipping operations. Consequently, many major sources of marine artificial light pollution remain either minimally regulated or nearly entirely exempt from effective restrictions. These gaps make it apparent that an international mandate is necessary to consistently address marine light pollution from the maritime industry.

[25] Marangoni et al., 5359–60.

[26] Dark Sky Database, "Non-U.S. Law Search," accessed September 3, 2026, https://idadb.cals.arizona.edu/foreign. The database compiles national, regional, and supranational laws addressing light pollution and outdoor lighting across jurisdictions worldwide and illustrates the range of regulatory approaches currently in use.

[27] Marangoni et al., 5359-60.

IV. Technical solutions

There are many proven and affordable ways to reduce marine light pollution, and many of these solutions are already in use. Turning off lights that are unnecessary is an effective first step, however lighting is still necessary for safety and operations. Automated and scheduled lighting systems can make sure lights are only on when needed, which would be more effective and efficient. Along with these basic steps, using warm colored LEDs and shielding are also proven ways to reduce the effects of marine light pollution.[28]

1. LEDs

The wavelength of LEDs strongly affects how much light reaches and impacts the environment. Blue and white LEDs (short wavelength light) penetrate much further into the water than other colors.[29] In contrast, amber and orange LEDs (longer wavelength light) do not penetrate as deep into seawater,[30] are less visible to sensitive species such as sea turtles,[31] and are commercially

[28] Marangoni et al., "Impacts of Artificial Light at Night in Marine Ecosystems," 5360-61.

[29] Colleen R. Miller and Aaron N. Rice, "A Synthesis of the Risks of Marine Light Pollution across Organismal and Ecological Scales," *Aquatic Conservation: Marine and Freshwater Ecosystems* 33, no. 12 (2023): 1592–93, doi:10.1002/aqc.4011; Smyth et al., "Global Atlas of Artificial Light at Night under the Sea," 10.

[30] Smyth et al., "Global Atlas of Artificial Light at Night under the Sea," 10; Moyse et al., "Artificial Light at Night Alters Predation," 92.

[31] Marangoni et al., 5351–52; Blair E. Witherington and Karen A. Bjorndal, "Influences of Wavelength and Intensity on Hatchling Sea Turtle Phototaxis: Implications for Sea-Finding Behavior," *Copeia* 1991, no. 4 (1991): 1060–69. Marangoni et al. conclude that hatchling sea finding is significantly compromised by shorter wavelength light even at relatively low intensities. In controlled experiments, Witherington and Bjorndal found that loggerhead and green turtle hatchlings preferentially oriented toward near ultraviolet, violet, and blue green light over yellow orange and red light. The IES source you provided reaches the same practical recommendation, specifically recommending native amber and red LEDs and warning against white sources because they contain shorter wavelengths visible to turtles.

available.[32] Longer wavelength LEDs could be switched out with shorter wavelength LED lighting systems currently used, offering a simple way to mitigate some light pollution harm.[33]

2. Shielding

Switching to longer wavelength LEDs alone will not resolve the issue of marine light pollution. Significant maritime lighting pollution occurs because many fixtures are unshielded or poorly oriented, causing light to spill into the water, along the shore, and up into the sky when it should be directed at certain surfaces. Picture large vessels with lights pointing in all directions. This problem does not require new technology for a solution.[34] Shielded light fixtures that direct light downwards and away from shorelines can substantially reduce the amount of light reaching the marine environment.[35] [36] Shoreline infrastructure can further mitigate impacts by employing precision optical controls which confine illumination to active work zones, thereby further eliminating light pollution spillover into the water.[37]

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[32] Imtra, "Marine Light Fixtures," accessed September 3, 2026; *Phoenix Lighting*, "CVO 2 | LED Area Light," accessed September 3, 2026. Imtra's current marine lighting catalog allows fixtures to be selected in amber, blue, cool white, neutral white, red, warm white, and several combination spectra, demonstrating that wavelength selection is commercially available in marine lighting. Phoenix likewise sells a marine certified area fixture in 5000 K, 2200 K, or amber LED configurations, and its broader marine catalog includes red, amber, blue, green, and white options.

[33] Yiğit, Kökkülünk, and Savaş, "Comparative Analysis of Ship Lighting Systems," 189–91. The study supports the general feasibility of replacing traditional shipboard lamps with LEDs, but not the wavelength-specific commercial claims in this paragraph.; Miller and Rice, "A Synthesis of the Risks of Marine Light Pollution" 1592–93, doi:10.1002/aqc.4011. Miller and Rice state specifically that short wavelength light travels farthest through the water column, that deeper marine environments are dominated by blue wavelengths, and that white LEDs generally contain more short wavelength light than older lighting technologies; those short wavelengths have been documented penetrating to approximately 30 m under some conditions.; Tidau, Svenja, et al. 2021. "Marine Artificial Light at Night: An Empirical and Technical Guide." *Methods in Ecology and Evolution* 12 (9): 1588–1601. https://doi.org/10.1111/2041-210x.13653.

[34] Marangoni et al., 5360–61.

[35] Marangoni et al., 5360-61.

[36] Moyse et al., "Artificial Light at Night Alters Predation," 92.

[37] Marangoni et al., 5360-61.

These recommendations do not advocate for complete darkness nor is it a suggestion that vessels remain completely unlit as safety remains a legitimate concern. The objective is to implement smarter lighting practices that reduce glow, utilize appropriate wavelengths, and deactivate lights when unnecessary.[38] Adjusting lighting is cost effective, does not disrupt essential activities, and would significantly reduce marine artificial light pollution. The necessary tools are a proven solution to marine light pollution and are commercially available for implementation immediately.[39] The remaining challenge is affirmatively deciding to implement these measures at an international scale and take the step towards mitigating marine light pollution.

V. How To Regulate Marine Light Pollution from the International Maritime Industry

Effectively addressing light pollution generated by the maritime industry will ultimately require a coordinated international approach that produces binding and consistently applied standards. The International Maritime Organization (IMO), potentially acting through the International Convention for the Prevention of Pollution from Ships (MARPOL), represents the most appropriate forum for developing such a framework.[40] MARPOL already regulates the emission of a variety of pollutants from the maritime industry, including garbage, sewage, and air pollution. Achieving this objective requires advancing marine light pollution through the IMO's formal

[38] Marangoni et al., 5360-61.

[39] Yiğit, Kökkülünk, and Savaş, "Comparative Analysis of Ship Lighting Systems," 190–91. In the bulk-carrier case study, replacing traditional lamps with LEDs was estimated to reduce lighting cost by about 53 percent, fuel consumption by about 59 percent, and installed lighting capacity by about 59 percent while providing similar or better brightness.

[40] International Maritime Organization, "Convention on the International Maritime Organization," arts. 1(a), 2, 37–41, accessed August 30, 2026; *International Maritime Organization*, "International Convention for the Prevention of Pollution from Ships (MARPOL)." Article 1(a) of the IMO Convention includes the prevention and control of marine pollution from ships among IMO's purposes, Article 2 authorizes the Organization to provide for the drafting of conventions, agreements, and other suitable instruments, and Articles 37–41 establish the MEPC and its functions. The characterization of IMO, and potentially MARPOL, as the "most appropriate" mechanism is the argument advanced by this paper rather than an established conclusion that artificial light already falls within MARPOL's substantive scope.

work-planning and rule-making processes.[41] This paper seeks to begin these processes by assembling initial scientific and policy records needed to support future IMO action.

1. Step 1: Generating Interest

The first step involves generating interest and opening the door for discussion to ensure engagement, as support from IMO Member States is critical for the subsequent processes. Securing momentum on this issue during the Marine Environmental Protection Committee (MEPC) session is essential before advancing the next step.

2. Step 2: Build the Evidence and Support

Before a proposal can successfully enter IMO's work programme, proponents must develop a documented case for action and build support among Member States and other IMO participants. IMO requires proposals for new work to demonstrate the need for action, expected environmental benefits, feasibility, proportionality, costs, existing industry standards, urgency, and the intended outcome.[42] IMO guidance also provides that submissions identifying shortcomings in protection of the marine environment should, where possible, suggest appropriate solutions and encourage contributions from outside organizations when further research is required.[43]

[41] International Maritime Organization, Organization and Method of Work of the Maritime Safety Committee and the Marine Environment Protection Committee and Their Subsidiary Bodies, MSC-MEPC.1/Circ.5/Rev.7 (May 26, 2026), secs. 3–6.

[42] International Maritime Organization, Organization and Method of Work, MSC-MEPC.1/Circ.5/Rev.7, para. 4.6 and Annex 1, items 1–10. Annex 1 requires proponents to document the need for the output and supporting evidence; analyze practicability, feasibility, and proportionality; address costs and administrative implications; identify expected benefits and relevant industry standards; specify the output in SMART terms; address the human element; demonstrate urgency; and identify the action requested.

[43] International Maritime Organization, Organization and Method of Work, MSC-MEPC.1/Circ.5/Rev.7, paras. 4.26, 4.30.

This paper begins that work by compiling evidence of ecological harm, identifying connections between maritime activity and artificial light, and evaluating existing mitigation measures. The scientific record already documents ALAN impacts across numerous marine species, habitats, and ecological processes, and identifies vessel traffic as an important area for further research.[44] Future work should therefore strengthen the record on vessel-specific impacts, available technologies, safety considerations, costs, and regulatory options.

3. Step 3: Submit a Proposal for a New Output

Formal consideration would begin with a proposal to MEPC for a new output.[45] Under the IMO Guidelines, the MEPC assesses proposals for new outputs before including them on its biennial or post-biennial agenda. Such proposals are submitted to the MEPC. Any Member State may submit a proposal by themselves, but a proposal submitted by an NGO must be co-sponsored by a Member State.[46] The proposal must demonstrate and document the need for IMO action and provide evidence supporting that need. It must also address the proposal's practicality, feasibility, and proportionality; costs and administrative burdens; expected environmental benefits; existing industry standards; human-element considerations; urgency; and the specific action requested. The intended output must be stated in specific, measurable, achievable, realistic, and time-bound terms, including the instrument to be developed or amended and its proposed scope of application.[47] A future proposal should clarify the binding regulation's objective while showing that mandatory

[44] Marangoni et al., 5346–61, The review synthesizes impacts across marine habitats and taxa and identifies the contribution of marine traffic, including mobile light sources from vessels, as a key question for future research.

[45] International Maritime Organization, Organization and Method of Work, MSC-MEPC.1/Circ.5/Rev.7, paras. 4.2, 4.6.

[46] International Maritime Organization, Organization and Method of Work, MSC-MEPC.1/Circ.5/Rev.7, paras. 4.6, 4.9–4.10.

[47] International Maritime Organization, Organization and Method of Work, MSC-MEPC.1/Circ.5/Rev.7, annex 1, items 1–11.

action is justified and workable. The precise legal mechanism, including whether regulation should occur through an amendment to MARPOL or another IMO instrument, could then be refined through the IMO process.

4. Step 4: MEPC Assessment and Inclusion

The Secretariat would first conduct a compliance check, after which a standing Group of Chairs, supported by the Secretariat, would undertake a preliminary assessment of the proposal. MEPC would then consider that assessment and the supporting documents, including whether the need for the output has been justified and documented, whether its practicality, feasibility, and proportionality have been demonstrated, whether it is expected environmental benefits are clearly stated, and whether adequate industry standards already exist or are being developed.[48]

Substantial scientific evidence already justifies advancing marine light pollution to this stage. A major review of marine ALAN research found documented effects across a growing range of species, habitats, and ecological processes and concluded that the accumulated evidence establishes ALAN as a widespread marine pollutant. At the same time, the review specifically identified the contribution and biodiversity impacts of mobile vessel lighting as a priority for additional research.[49] The evidentiary question is therefore increasingly not whether artificial light can harm marine ecosystems, but how much the maritime sector contributes to that harm and which regulatory measures are appropriate.

[48] International Maritime Organization, Organization and Method of Work, MSC-MEPC.1/Circ.5/Rev.7, paras. 4.12–4.15 and annex 8, pt. 2.

[49] Marangoni et al., 5361. The authors conclude that the expanding number of documented species, habitats, and ecological processes presents a strong case for ALAN as a widespread marine pollutant.

Following its assessment, MEPC may decline the proposal if the applicable criteria have not been satisfied, accept the output for the next biennium, or include it in the current biennial agenda, where the demonstrated need and the implications for workload and planning support doing so. MEPC's decisions on proposals for new outputs are reported to the Council for endorsement.[50]

5. Step 5: Adoption and Entry into Force

Once MEPC accepts an output, it determines how the substantive work should proceed and may assign technical work to one or more subsidiary bodies. When MEPC assigns work to a subsidiary body, it must provide clear, detailed instructions, preferably through terms of reference. MEPC may also establish working, drafting, technical, or correspondence groups where appropriate.[51]

At this stage, the scientific foundation developed through the earlier steps would be translated into regulatory requirements, potentially including covered light sources, technical or operational standards, mitigation technologies, and protections for navigation and crew safety. The scientific foundation is substantial and continues to expand. Recent research has associated marine ALAN with altered coral broadcast spawning, changes in predator-prey interactions, and changes in sea urchin grazing, adding to previously documented impacts involving seabirds, sea turtles, fish, zooplankton, corals, and other marine organisms.[52]

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[50] International Maritime Organization, Organization and Method of Work, MSC-MEPC.1/Circ.5/Rev.7, paras. 4.19–4.23.

[51] International Maritime Organization, Organization and Method of Work, MSC-MEPC.1/Circ.5/Rev.7, paras. 4.24–4.25, 5.17–5.25, 5.35–5.37.

[52] Marangoni et al., 5346–61; Thomas W. Davies et al., "Global Disruption of Coral Broadcast Spawning Associated with Artificial Light at Night," *Nature Communications 14* (2023): 2511, 1–3, https://doi.org/10.1038/s41467-023-38070-y; Emma Moyse et al., "Artificial Light at Night Alters Predation on Colour-Polymorphic Camouflaged Prey," *Basic and Applied Ecology 73* (2023): 88–92, https://doi.org/10.1016/j.baae.2023.11.002; Amelia Caley et al., "Artificial Light at Night and Warming Impact Grazing Rates and Gonad Index of the Sea Urchin Centrostephanus rodgersii," Proceedings of the Royal Society B 291 (2024): 20240415, 1–2, https://doi.org/10.1098/rspb.2024.0415.

Vessel-specific evidence remains less developed, but the connection is not merely theoretical. Existing literature identifies vessels and offshore platforms as artificial light sources at sea, reports potential impacts in both epipelagic and mesopelagic environments, and documents vessel lighting as altering ecological interactions, including seabirds congregating near fishing lights that concentrate prey.[53] The remaining research gap identified in the literature is therefore the scale and biodiversity consequences of vessel-generated light, rather than the existence of vessel lighting as a source of marine ALAN.[54]

6. Step 6: Adoption and Entry into Force

Once the technical work is complete, the resulting measure would return to MEPC for approval and, where appropriate, adoption. If the final measure takes the form of an amendment to MARPOL, its proposal, adoption, acceptance, and entry into force would proceed under MARPOL article.[55]

Marine light pollution does not need to arrive at IMO with every scientific and technical question already resolved. IMO's own process contemplates further research and technical development after an issue has been accepted for work.[56] What is needed first is a well-supported environmental problem, credible potential solutions, and sufficient evidence to justify further action. This paper provides a foundation for that process. Next is to strengthen vessel-specific evidence, evaluate the

[53] Marangoni et al., 5357, 5359.

[54] Marangoni et al., 5361.

[55] International Maritime Organization, Organization and Method of Work of the Maritime Safety Committee and the Marine Environment Protection Committee and Their Subsidiary Bodies, MSC-MEPC.1/Circ.5/Rev.7 (May 26, 2026), annex 2, paras. 4.2–4.3; annex 5, para. 3.10.

[56] International Maritime Organization, Organization and Method of Work, MSC-MEPC.1/Circ.5/Rev.7, paras. 4.30, 5.8–5.9. The Guidelines encourage contributions from outside organizations and appropriate entities on subjects requiring research and provide for technical work to continue in subsidiary bodies once authorized by the parent Committee.

feasibility and proportionality of potential measures, build Member State support, and translate that record into a proposal that meets IMO's requirements for a new output.

Conclusion

Marine light pollution from the maritime industry poses a significant environmental threat, directly contributing to biodiversity loss and the ongoing degradation of marine ecosystems. Without binding regulations addressing some of the most significant contributors to marine light pollution, the maritime industry will join the ranks of the world's great polluters. This paper explained the effects of marine light pollution, demonstrated the need to prioritize the maritime industry in regulatory efforts, and outlined a step-by-step approach to implementation through the International Maritime Organization. The regulatory framework is already established and scientific evidence is unequivocal. It is now up to the Members of the IMO to take decisive action and fulfill their mandate: protect the marine environment from the impacts of pollution from ships.