

Artisanal Ruby Mining in Myanmar: Environmental and Social Impacts

Sally Dickinson DeLeon, Summer 2007

This report was prepared as part of a master's thesis on gemstone jewelry supply chains and their relationship to artisanal and small-scale miners. This short overview was created to supplement a project conducted by Dr. Saleem H. Ali on the environmental and social impacts and benefits of gemstone mining funded by a grant from the Tiffany & Co. Foundation. Sally DeLeon was a Tiffany Scholar at the University of Vermont for the 2005-2006 academic year when she was in the beginning stages of planning her master's thesis. Her full thesis is expected to be available in 2008.

Legend has it that the Valley of Rubies was created in ancient times when *Naga* (a serpent) laid three eggs: out of the first hatched the King of *Pagan* (the major region in ancient Burma), out of the second hatched the emperor of China, and the third egg was stolen away by a hunter but he accidentally dropped it in a stream. The third egg cracked and released all of the precious rubies that spread throughout the land of Myanmar's modern day stone tract. Burma has always been strongly associated with high-quality rubies since the earliest European contact. Starting with the ancient kings and dynasties of Burma, and ending with the current military-junta dictators, most of the political leaders of this region have been renowned for the way they have made rubies symbolic of their power. An early Italian explorer wrote of a regional king in Burma who wore so many large red rubies "that seeing the person of the king by a light at night, he shines so much that he appears to be a sun."¹ Fine ruby displays luminescence and its ability to fluoresce and phosphoresce gave a mysterious aura of power to this king and other wearers. Than Shwe, the current military dictator of Myanmar, and his predecessors have regimented tight controls over the country's mines and until recently declared all gemstones to be the property of the State no matter who unearthed them; stealing rubies from the State was punishable by death or lengthy imprisonment. Aung San Suu Kyi, Myanmar's first democratically elected leader who won the Nobel Peace Prize in 1991 for her efforts to lead Myanmar's people to stand up for their freedom, is the notable exception to this formula of rubies, fear and power. She has been kept under house arrest for most of the last 19 years by the power-hungry junta. Just as the Burmese creation legend suggests, the strong ties between rubies, political power, and China may be part of what is allowing the continuation of the human rights violations, environmental degradation, and extreme inequity for which Myanmar has become so notorious; if these ties could somehow be severed, perhaps peace and prosperity could finally take hold. Rubies are not the key to democracy and an end to human-rights violations—the revenue they generate pales in comparison to the junta's earnings from oil and gas, and more of the official gem revenues are from jade than from rubies—but they are a piece of the puzzle. This report is an attempt to examine how rubies are mined in Myanmar and how their flow relates to the social and environmental well-being of communities therein.

Mining History

At the northwest end of the Shan Plateau, in the vicinity of the Irrawaddy River, lies the Mogok stone tract. The mines of Mogok, and sub-mines in the surrounding area have produced many of the finest rubies in the world. In addition to rubies, the land yields sapphires, spinel, peridot, aquamarine and a variety of other semi-precious stones. The L-shaped stone tract is estimated to be 1916 square miles in area.² Ruby was probably first discovered in this region by stone-age humans during the Middle Pleistocene.³ From



Figure 1: Map showing the most important gem mining localities in Myanmar.

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http://www.palagems.com/gem_spectrum1.2.htm

the early centuries up until about 400 years ago, the region was ruled by a succession of princes in the Shan dynasty. In 1597 the Burmese king forced the Momeik *sawbwa* (prince) to trade Mogok and Kyatpyin for a stoneless area called Tajaungmyo.⁴ The king held direct control over the ruby mines for a few years before the British East India Company made its first contact with Burma and began to act on an interest in developing the gem trade. During the almost 300 years when Mogok was ruled by Burmese kings, forced slave labor was common in the mines and people were punished severely for attempting to hide valuable stones. In the early nineteenth century the British won the first Anglo-Burmese war, and at the end of 1885 the British took Mandalay, ousting the last king of Burma, Thebaw, from power. From 1889-1925, the Burma Ruby Mines Ltd. operated extensive mechanized mining at Mogok, but the company was eventually forced to go into voluntary liquidation because of declining returns and a slumped market in the face of World War I. From 1926-1947, mining was executed mainly by native artisanal methods and continued that way after Burma achieved independence in 1948. In 1962 General Ne Win seized power in a military coup and in 1969 his Ministry of Mines banned private exploration and gem-mining; ruby and jade mining licenses previously issued to prospectors were revoked and all gems were declared military property. Little information is available to the outside world about how mining proceeded after Burma (now called Myanmar) was roped into the extreme isolation regimented by this long-running military dictatorship.

However, in the mid-1990s Myanmar opened up ajar to admit private interests and tourists from the outside world. Gemstone and jade mining were slightly liberalized and expanded. The major ruby mining areas of today, as shown on the map in **figure 1**, include the Mogok Stone Tract, and Mong Hsu in Shan State, while jade and the rarer jadeite are primarily mined in Kachin State around Hpakant. Some smaller ruby mining areas also became official sources in the 1990s at Nawarat (also called Pyinlon) and Namhsa in Shan State, Sagyin (near Mandalay), Thabeitkyn and Kathe along the Irrwaddy River west of Mogok, Namya, which is located in Kachin State a few miles from Hpakant near the Chinese border, and others.

Mining Methods and Society in Mogok

Alluvial deposits, where rubies have been transported from their original parent rock by weathering into streams and rivers along the valley floors of this mountainous region, are the source of most of the gemstones that have been mined in Myanmar. In recent years, new technologies have allowed miners to penetrate primary deposits and as of the end of the millennium, there were about 1000 mines operating in the Mogok Stone Tract, approximately half in *byon* (deep gravel of ancient alluvial deposits) and half in bedrock⁵. Four traditional types of mines operate in Mogok (as of the 1990s) and these are detailed in **table 1**. There are also some open-cast mechanized mines that have replaced the mechanized mining efforts of the British Empire.

Table 1: Traditional Mine Methods of Mogok, adapted from Hughes (1997): 324-327.

Type	Used for	Technique
<i>Twin-lon</i> or pit	Mining the soft alluvial earth in the valleys	2-3 men work together to sink a small round shaft (3-24 m deep) straight down to the <i>byon</i> (gem-bearing gravel) and a small basket on a long-bamboo pole, with a counterweight or a hand-cranked winch, is used to haul up the earth.
<i>Hmyawdwin</i> or open trench	Excavating hillside surface deposits	A stream of pressurized water is directed to the upper end of an open cutting on a hillside and thus sweeps away the lighter material and mud effectively concentrating the heavier gem-bearing material to be scooped up and carried to a suitable site for washing, usually in a stream or river.
<i>Ludwin</i> or cave system	Extracting gem-bearing earth that fills limestone caves	Using a variety of hand-held tools, tunnels are excavated into hillsides to follow veins of <i>byon</i> to caverns in the limestone that form when impurities in the rock are dissolved by minerals in the groundwater; these caverns are often filled with deep layers of <i>byon</i> which is hauled out to the surface for washing.
Quarrying (tunneling)	Tunneling directly into host rock to extract stones	Dynamite and more modern forms of blasting are used to extract both ruby and sapphire from hard rock deposits.

Flooding by groundwater is a constant challenge especially in the *twin-lon* method. Hand-powered bamboo pumps as well as diesel-powered pumps are often used to remove the previous night's water at the start of a work day, and twin mining ceases during the monsoon season (June-October). Since the *hmyawdwin* method requires an abundant

supply of water, it is carried out mainly during the rainy season. The *ludwin* and quarrying methods are not as common as twinlons and hmyawdwins, but some of the richest discoveries have been made in the caverns and crevices revealed in the limestone bedrock through tunneling. Mechanized mines opened in the era of the Burma Ruby Mines Ltd. and some have been operating in a number of locations since then. These generally involve large pits with centrifugal pumps planted in the middle to dry out the surrounding earth so that mines can work on the *byon* adjacent to the hole. Trucks may be used to haul excavated *byon* to a washing plant, where it is processed by machine through a series of screens and washing pans. However, the washing of *byon* is most commonly done in the traditional way since most mining in Mogok and the other important ruby mines are not mechanized. Large rocks are used to build a shallow enclosure, with a slight slope at one end, to contain the *byon*. A stream of water is directed onto the mound of *byon* while it is stirred and the lighter material flows out of an opening in the rocks at the sloped end of the enclosure. The remaining heavy material is removed for washing on circular bamboo trays, also commonly done in shallow enclosures. Poor people with hereditary rights to gem mine tailings, called the *kanase*, are given spoils from the mechanized open-pit mines as well as *byon* left over from the artisanal washing enclosures. The *kanase*, originally just women, wash this gravel in local streams to search for small spinels and other semi-precious stones.

The *kanase* could be viewed as a symbol of the amazing social-system that has organically emerged in Mogok. The size of the population of the Mogok area is unknown, but it includes Burmese and Shan (Buddhist ethnic groups), Nepalese Ghurkas (Hindu), Lisu (Christian and Animist), as well as smaller numbers of Muslims, Sikhs and people of Eurasian origin. Despite differences in ethnicity, religion, language, politics and history, the people of Mogok compete for a stake of the ruby income while cooperating to ensure that everyone has a role to play and a way to participate. In the face of many risks associated with finding, possessing and selling rubies [elaborated on below in the section on Gemstone Mining Regulation], various groups have settled into niches, parts of a whole network that responds to the official channels for ruby production and drives the unofficial channels as well. The peaceful coexistence of all of these groups, and the system of cooperation that they have developed in the face of their common enemy—poverty—is an inspiring story for other ethnically fractured societies.

Ruby Processing

Mogok rubies are considered the finest rubies in the world because of their natural deep color, clarity, fluorescence, and lore. Due to recent extensive mining around Mogok since the 1990s, these stones are becoming increasingly rare. It is estimated that as of the early 2000s, 95% of all the faceted rubies on the world market come from Mong Hsu.⁶ Unlike the Mogok Stone Tract, the geology of Mong Hsu is not such that the rubies are a clear, deep, rich shade of “pigeon-blood” red, but instead often have a cloudy bluish-purple tinge and core. In general Mong Hsu rubies cannot be faceted without first being treated in high-temperature furnaces. They are treated both to improve the color and clarity and to heal deep fractures that are characteristic due the geological nature of Mong Hsu. The natural fractures usually cause untreated Mong Hsu stones to break during faceting, so these cracks must be sealed together by high-temperature heating with flux-

glass in order to improve chances of success during cutting and polishing. Even with heat treatment, buyers' experiences have shown only a 10-30% range of success with cutting good stones from Mong Hsu rough⁷. While many stones from the Mogok region are cut and polished in the town of Mogok, or in Mandalay or Yangon, Mong Hsu stones are usually sold to Thai gem dealers in rough form. In Bangkok, where heating technology, heating expertise, education and willingness to take risks far exceeds Burmese levels of these resources, Thai "cookers" or "burners" treat the Mong Hsu rough in their furnaces. The treated rough is then offered for sale and may be cut and polished in Thai lapidary shops or taken abroad by dealers for cutting in China, India, the United States or a number of other places.

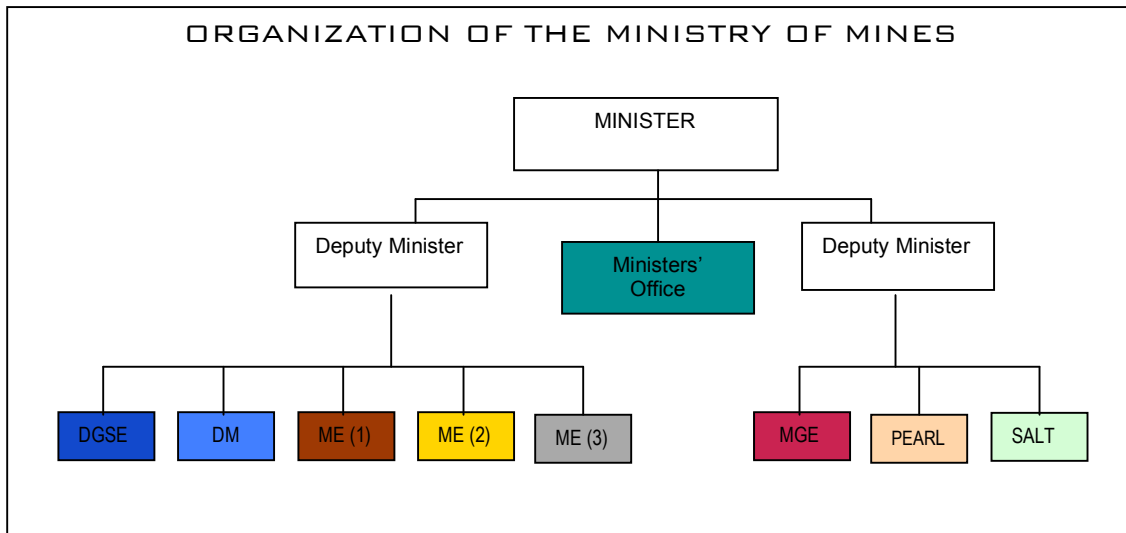
Gemstone Mining Regulation

When Ne Win, the first military ruler of Burma who staged a breakthrough coup in 1962, retired after widespread protests calling for liberalization in 1988, a new military junta took control. Many of Ne Win's old aides were part of the new State Law and Order Restoration Council (SLORC). Headed by Senior General Saw Maung, the SLORC seized power after violently crushing the peaceful civil society protests of August 1988 by shooting as many as 3000 people. The peaceful movement for political change had emerged around Aung San Suu Kyi, the beloved daughter of 1940's freedom fighter Aung San and leader of the popular political opposition party, the National League for Democracy (NLD). SLORC declared martial law, renamed the country from Burma to Myanmar, and placed Suu Kyi under house arrest. In a 1990 parliamentary election, the only one ever held in Myanmar, the NLD won a majority of seats but the SLORC annulled the results and refused to give up control of the legislative process. The State-Owned Economic Enterprises Law (SLORC Law No. 9/89) was issued in 1989 when the junta was in the early stages of introducing some market economy policies after 26 years of nationalized socialism. Chapter 2, section 3 of this law clarifies which economic activities will continue to be carried out only by the State including "... Exploration, trading, extraction and export of pearl, jade, ruby and other mineral precious stones."

In 1992 General Saw Maung resigned unexpectedly for health reasons, and was succeeded by one of his cabinet members, Senior General Than Shwe. Under new leadership, economic policies were relaxed somewhat to permit more foreign investment and infrastructure development. The Myanmar Mines Law of 1994 (SLORC Law No. 8/94) reformed the mining codes and made clear that no mining company can be held liable for prosecution or fines. Ironically, this law also contains some provisions about environmental protection at mine sites, but no clear way to enforce them. In 1995 the policy landscape for gemstone mining was modified when the junta issued the Myanmar Gems Law (SLORC Law No. 8/95). This law laid the groundwork for private companies and mining cooperatives to enter into joint ventures with the State to mine for precious stones, allowing foreign companies, or native ethnic groups to hold a minority-stake in a particular gem mine. The law also allows landowners to apply for permits to mine rubies provided that they sell them through government-approved channels and pay associated fees and royalties. In keeping with the 1994 National Environment Policy, Law 8/95 Section 12 (a) requires that all applicants for permits from the Ministry of Mines conduct an Environmental Impact Assessment (EIA) prior to receiving official approval to extract

gems, and that the Myanmar Gems Enterprise (MGE) investigate whether gemstone mining activities under each particular permit will negatively affect the environment, flora and fauna, highways, religious property, and/or cultural heritage items. The MGE is the official overseer of gemstone mining rights and grants permits to business people who wish to legally mine for gemstones or jade in Mogok, Mong Hsu, Namya, Hpakant and other areas. The MGE is also responsible for permits to process gemstones and to manufacture them into final products. **Figure 2** shows the organizational structure of the Ministry of Mines, including the role of the MGE.

Figure 2: Institutional Structure and Human Capital of the Myanmar Ministry of Mines, adapted from Samuels (2003): 163.



Acronym	Department	Responsibilities	Human Resources	
			Officers	Staff
MO	Ministers' Office	Cabinet of the Minister of Mines	Officers	7
			Staff	34
			Total	41
DGSE	Department of Geological Survey & Mineral Exploration	Geological Surveying and Mapping, Mineral Exploration, Metallurgical Research	Officers	251
			Staff	1219
			Total	1470
DM	Department of Mines	Mineral Policy and Law Formulation, Safety and Environmental Control, Royalty Collection, Planning	Officers	23
			Staff	43
			Total	66
ME (1)	Mining Enterprise #1	Lead, Zinc, Silver, and Copper	Officers	201
			Staff	6405
			Total	6606
ME (2)	Mining Enterprise #2	Gold, Tin, Tungsten	Officers	201
			Staff	4027
			Total	4228
ME (3)	Mining Enterprise #3	Iron & Steel, Coal, and Industrial Minerals	Officers	199
			Staff	3132
			Total	3331
MGE	Myanmar Gems Enterprise	Rubies, Sapphires, Jade, Colored Stones, and Jewelry Manufacturing	Officers	68
			Staff	759
			Total	827
PEARL	Myanmar Pearl Enterprise	Cultured Pearls, and Artificial Breeding of Mother Pearl Oysters	Officers	30
			Staff	331
			Total	361
SALT	Myanmar Salt & Marine Chemical Enterprise	Salts by Production from Brine	Officers	22
			Staff	367
			Total	389

Since it was created in 1988 to replace the old Myanmar Gems Corporation, the MGE has hosted annual gem auctions, which until 2002 were only one of two ways to legally buy rubies and other gemstones from Myanmar. The Union of Myanmar Economic Holdings Limited (UMEHL) began selling rough stones, mainly from Mong Hsu, and jade at its own annual auctions in the mid-90s. Currently, MGE and UMEHL auctions are held several times a year and interested buyers can also purchase gemstones through official channels online, at the Gems Museum and Mart in Yangon, at the Myanmar Joint Venture VES Company store next to the museum, or at licensed hotel shops and outlets in Yangon and Mandalay.

In 1997, the junta announced that it was changing its name to the State Peace and Development Council (SPDC) and some members were replaced. The SPDC maintains local strategic command offices all over the country, including in mining areas. The decisions of the MGE office in Mogok are reportedly controlled by the local SPDC office, and independent local mine owners who apply for permits are often delayed for so long that they have no choice but to sell their land to foreign Chinese and Indian investors to avoid further accumulation of debt.⁸ Land seizures by military personnel are not uncommon when valuable gem-bearing pockets are revealed therein. Due to the risks and economic uncertainties of legal gem entrepreneurship, many independent miners prefer to mine secretly, risking imprisonment and worse, and sell through shadow networks that smuggle rough stones across international borders into Thailand, China, India and elsewhere. Enforcement of environmental regulations is virtually non-existent in legalized mining operations, and certainly non-existent for illicit operations. Citizens have no way to seek recourse for relevant health problems and environmental damage done to land, waterways and wildlife in mining areas.

Environmental Impacts of Ruby Mining

The Valley of Rubies (the Mogok Stone Tract) is surrounded by three to six thousand foot-high mountains, which form a natural amphitheater and were at one time covered with dense tropical forests, which were home to tigers, leopards, bears, reptiles and other predators. Today, the once-admired teak forests are absent and large cats are now locally extinct, but some remain in other parts of the country. Monkeys, bears, wild-boars, snakes and birds still inhabit the Mogok region.⁹ The Kyauktaung Reserve, the Hintha Reserve, the Ondok Reserve, and the small Chaungyi Reserve all border on the mining areas. Burmese miners at the turn of the last century used to hunt in these forests and return to camp with slain animals to eat; it is not difficult to imagine that those who mine the valley today still depend on the forest for food as well as for materials necessary to sustain shelter, warmth and other human needs. Forest resources are commonly used to construct mine shafts and other structures. Timber, twigs and leaves are used for shoring up the side tunnels of *twin-lon* shafts and for alternative types of shafts in areas where the earth is not compact enough for twinlons. Nonetheless, prior to 1995, the effects of gemstone mining on the Burmese environment had been negligible since the days of the Burma Ruby Mines Ltd. Because most mining was done slowly using traditional methods, and most of the gem deposits were not found close enough to major river, lake

or marine ecosystems (with the exception of a few sites along the Irrawaddy River) to cause serious damage from siltation, environmental damage existed on a relatively small scale. With the advent of larger mechanized mines backed by foreign investors who could not easily be held to any liabilities, ruby, sapphire and jade mining became a serious threat to habitat preservation and biodiversity. Dynamite and powerful equipment have allowed the new mines to extract a lot of material in a short period of time, and the resulting environmental damage around Mogok and Mong Hsu is extensive.¹⁰ Although little research has been done, international environmental NGOs are extremely concerned about the state of biodiversity in Myanmar.

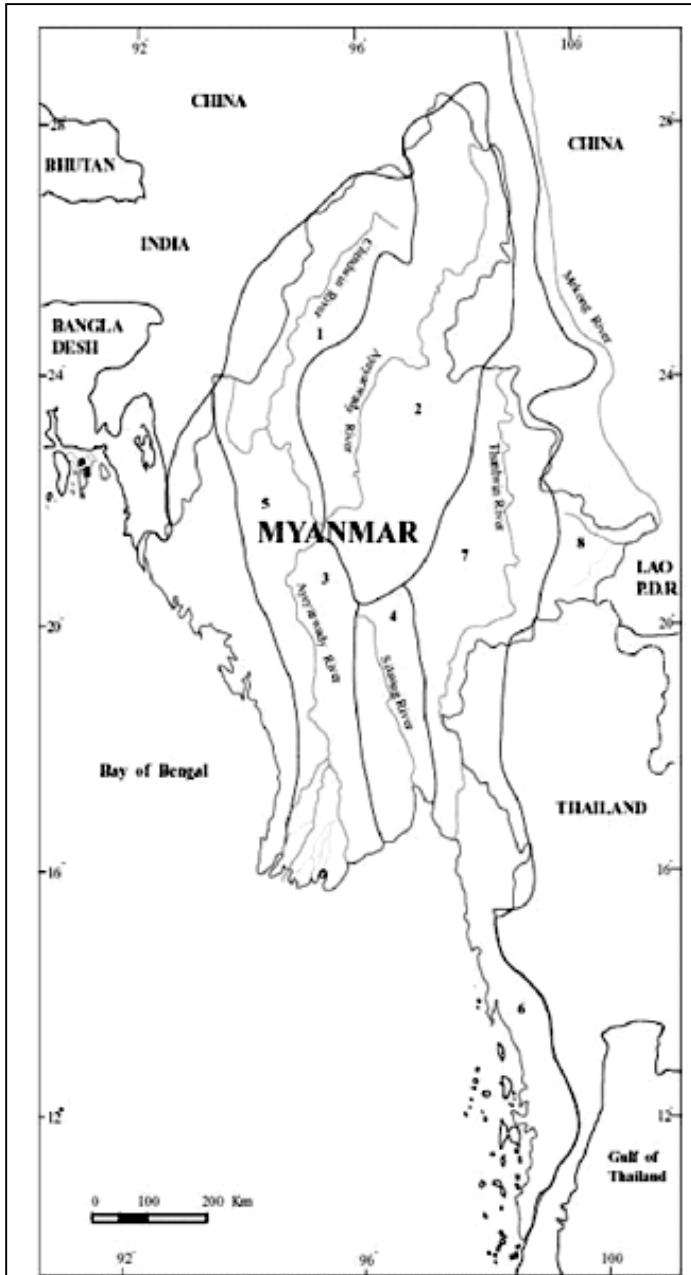
The Salween River, which is the second largest river in Asia after the Mekong, flows close to Mong Hsu and some mines are located along its banks. With headwaters in Tibet, a course through the Yunnan Province of China, the eastern side of Myanmar and the western border of Thailand, the Salween is truly an international eco-region. Inside Myanmar it is commonly known by its' Burmese name, Thanlwin. **Figure 3** shows the watershed basins of all the major rivers in Myanmar, including the Salween shown as basin #7. Downstream from the ruby mining area it flows around 800 km before it enters the Andaman Sea at Moulmein. Approximately 140 species of fish inhabit the Salween, one-third of which are endemic to this river¹¹. The river also contains one of the most diverse turtle communities in the world, including the endangered big-headed turtle (*Platysternon megacephalum*) and several threatened and vulnerable species. Erosion and siltation of the river is accelerated by gemstone mining activities and can damage habitats, reduce oxygen availability for aquatic species, and affect water temperatures leading to a loss of biodiversity. Since the ecological structure of the river is much of what allows it to provide food and a clean, continuous supply of water for local people and animals, the effects of changing this structure can be disastrous. These concerns have been echoed in the controversy surrounding the junta's plans to build a series of large dams on the Salween for hydropower generation.

The topic of preservation of endangered species, while on the whole less concerning than large-scale deforestation, destruction of biodiversity, and changes to the physical and ecological structures of river systems, is part and parcel with wildlife conservation in Myanmar. In general, hunting, over-fishing, logging, oil and gas exploration and gold-mining are the gargantuan threats to the threatened and endangered plants and animals. However, gemstone mining also plays a role, especially when it is carried out with dynamite, powerful machinery and inattention to soil erosion near waterways. The World Conservation Union (IUCN) estimates the remaining wild population of the critically endangered Irrawaddy River dolphin (*Orcaella brevirostris*) at 59 individuals.¹² IUCN research has shown that a large number of gold mines operate along the Irrawaddy River (watershed basins #2, 3, and 5 in **Figure 3**) in regions of preferred habitat for this dolphin and the toxic mercury, large boat dredges, hydraulic land blasters and noise of these mechanized gold mines pose a major threat to the survival of the species. Small-scale gemstone mining is much less detrimental to the dolphins than the gold mining, but nonetheless, siltation from gravel blasting and washing could harm the health of one of the few-remaining Irrawaddy River dolphins in the world. The same reasoning holds true for critically-endangered birds that depend on the Irrawaddy and Salween River habitats.

Birdlife International is particularly concerned about changes to wetland habitats that are extremely important for threatened and endangered birds in the Irrawaddy River plains, downstream of ruby mining areas.¹³ However, the amount of additional silt added to rivers from gemstone mining activities is probably not enough to alter wetland habitat

structures significantly on its own. When combined with silt and soil resulting from agricultural land, logging, large-scale gold mining and hydrological changes caused by dams, silt from gemstone mines alone has a negligible effect on downstream habitats.

When shafts (from the *twinlon* method, caverns from the *ludwin* method, and tunnels) are abandoned and left open when mining is finished, they can become hazards for wildlife, livestock and unsuspecting people. Abandoned pits are perhaps the longest-lasting environmental legacy of artisanal and small-scale gemstone mining in Myanmar. Particularly in areas where large mammals roam the ground, they may act as traps. They often become filled with water, and if small enough in diameter may appear as harmless, shallow puddles through which it is safe to walk. Standing water collecting in pits constitutes a breeding-ground for disease-carrying insects leading to stronger vector populations for malaria and Japanese encephalitis. Once again, the scale of these disturbances is minor from artisanal mining in Myanmar, particularly because much of it is done secretly so pits may need to be refilled and minimized in proximity to one another to avoid attracting attention from officials. Concern about abandoned pits



Map of Myanmar River Basin

Figure 3: Map of River Basins in Myanmar showing the passage of the Thanlwin (Salween) River and the Irrawaddy River.

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from the international conservation organizations has been aimed mainly at the large-scale gold mining going on in and around the newly created Hukawng Valley Tiger Reserve in Kachin State.

Conclusion- Balancing Myanmar's Ruby Costs and Benefits

Rubies are a rich and important part of the culture and story of Myanmar. To argue that they are more of a curse than a blessing would be missing the point that they are inherent in the Burmese way of life, both the wonders and the wickedness. There is no way to measure all the contributions Burma Rubies have made to society. However, without a doubt rubies have brought livelihoods and valued traditions to the people of Mogok. When they are mined in the traditional, artisanal-style ways the harm caused to ecosystems is negligible—after all it has been going on four thousands of years. Ecological damage from artisanal and small-scale mechanized mines could be contained with little technical difficulty and capital, but education and environmental justice pose more daunting challenges. While environmental regulations are vague and out-of-date, it seems unlikely that the majority of miners would comply with stronger regulations due to lack of appropriate institutions for enforcement. Furthermore, many hereditary mining families deeply resent the government for their nationalization policies, ties to Chinese and Indian investors, unfair pricing policies, and general abuse of non-Burman ethnic groups. Because of this deep-seated conflict, smuggling and hiding gem deposits from the junta have evolved into proud creative art forms. For many families involved in the mining and gemstone processing businesses in Myanmar, selling a ruby is their only hope of escaping poverty. Other than illegal teak or heroine trading, there are few alternative livelihoods to gemstones that allow people to earn enough income to survive.

In the puzzle of how to build stronger human rights and environmental governance in Myanmar, rubies are still a conundrum but one thing about them is clear: they are not the logical first step for leveraging a brutal regime. Because rubies are deeply integrated in the history, mythology and social systems of the places from which they are mined and traded, any policy effort to eradicate the ruby economy without fully understanding it could have serious unintended consequences for the social and environmental well-being of communities in these places. Jade, gold, oil and gas, all of which are more economically viable to the SPDC than rubies, are not as easy to smuggle as rubies nor are they as mired in religious faith and hope. Furthermore, rubies and other small precious stones are more amenable to artisanal mining than jade or gold because of their geological nature. If human rights for marginalized peoples is the international priority in Myanmar, then rubies may best be left as an avenue of hope for the poorest miners while work is undertaken to cut off streams of power and revenue from the larger natural resource honeypots.

Endnotes

¹ Ludovico di Varthema of Bologna as quoted from Temple (1928) by R.W. Hughes on page 307 of *Ruby & Sapphire* (1997)

² George (1961) as referenced by Samuels (2003) on page 117 of his chapter on the Mogok Stone Tract

³ Hughes (1997)

⁴ George (1915) as referenced in Hughes (1997)

⁵ Waltham (1999): 145

⁶ Hughes (2004)

⁷ Samuels (2003): 158

⁸ MacLean (2003)

⁹ Themelis (2000): 85

¹⁰ Gutter (2001)

¹¹ WWF (2006)

¹² IUCN (2007)

¹³ BirdLife International (2003)

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