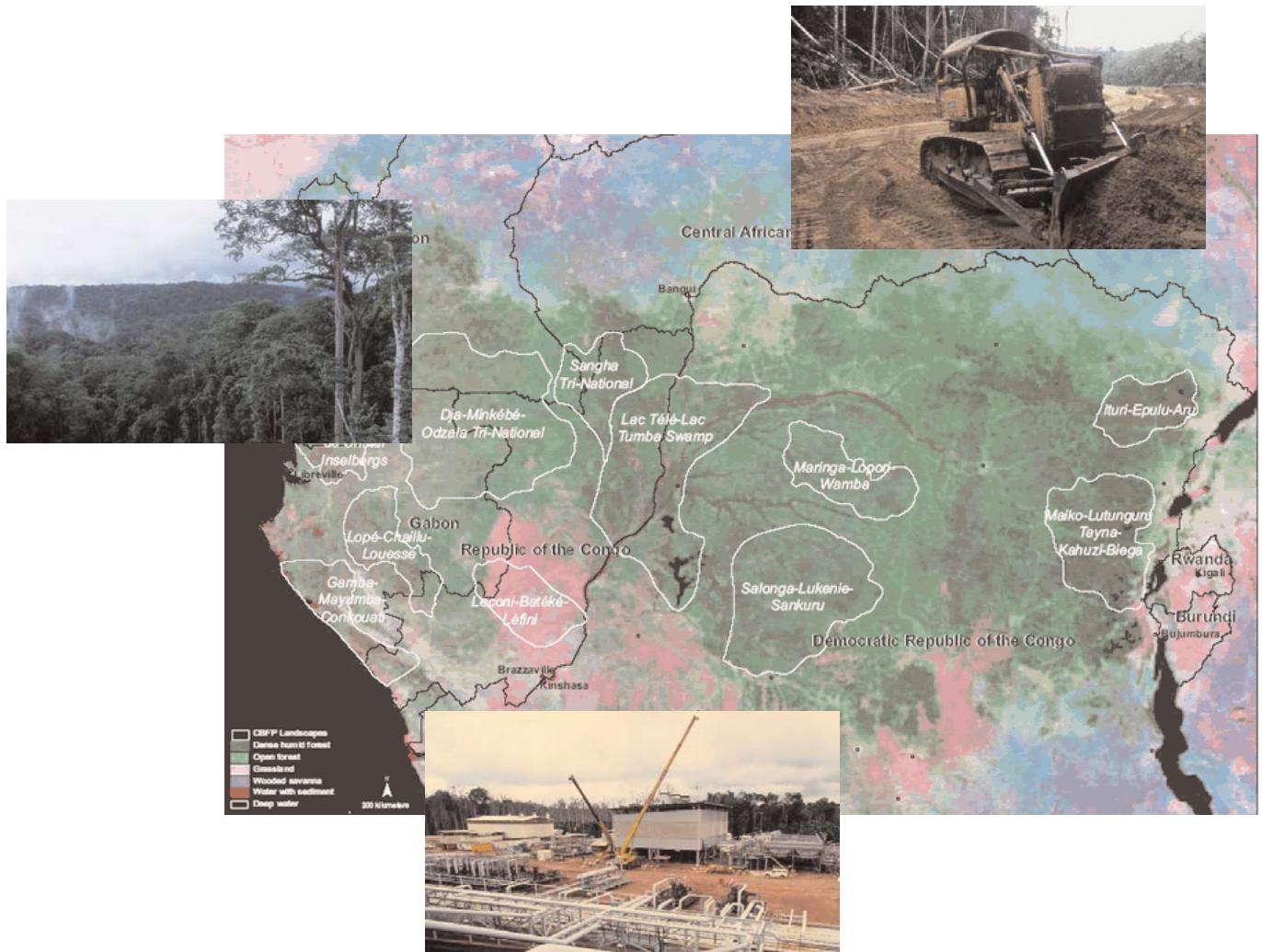




# Assessment of the Mining Sector and Infrastructure Development in the Congo Basin Region

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## Executive Summary

The Congo Basin Region (CBR) has many remarkable natural resources, including many endemic species as well as megafauna. Conservation interests in the region must be balanced against the development goals of countries that rely heavily on the export of such minerals as oil, gold, diamonds, manganese, iron ore, and wood products. Several countries, notably Cameroon and Gabon, are facing declining oil revenues that could encourage their respective governments to bolster revenues by developing mineral resources found within conservation priority areas. The Democratic Republic of Congo (DRC) could be stabilizing, and its natural resources (especially the mining and forestry sectors) have been identified as the predominant sectors for reviving the economy. The Democratic Republic of Congo is facing many distinct challenges, including political instability, and could renew interest in and production at several viable mining sites in the future if stabilization or sector restructuring occurs. Equatorial Guinea has a growing economy based on inflows of oil revenues and remains relatively closed to the international community. The Central African Republic is one of the poorest countries in the world, but it has a relatively undeveloped mining sector. If corresponding physical infrastructure is developed, it potentially could have several viable deposits.

High world demand for minerals and high prices are increasing pressures for the development of mineral deposits. Given the high demand for these commodities, companies are offering to build much of the needed infrastructure to develop mineral deposits that are located within, or in proximity to, several of WWF's high-priority conservation regions. Proposed infrastructure development is substantial in some cases, including roads, railways, power plants, and ports. Infrastructure development remains one of the biggest threats to protected areas, resulting in the degradation of forests by opening access to otherwise intact and remote areas. As forests are opened for logging and mining, bushmeat hunting is likely to increase, dramatically affecting wildlife populations. Agriculture threatens forests because large areas of land are cleared or burned. Increased agriculture is often a result of government policy, and the increased competitiveness for agricultural goods may be a result of decreasing oil revenues.

Several countries in the CBR have implemented important initiatives to conserve their natural resources. Limited monitoring and maintenance of protected areas and failure to uphold legislative initiatives to protect the rich biodiversity and natural resource wealth could diminish these efforts to protect natural resources and harness their potential for future economic, cultural, and social use.

## Conclusions and Key Findings

*Infrastructure associated with mining and logging poses a substantial threat to forests—the indirect impacts from mining and logging can be more harmful than direct impacts through deforestation, pollution, and natural resource degradation.*

*High mineral prices are encouraging the development of mineral deposits, including the development of previously unviable deposits—companies are increasingly willing to invest substantial resources into developing mineral fields, including major infrastructure construction.*

*Governments that rely on oil wealth may be facing shortages that encourage nonoil mineral development or pressures to increase logging or agricultural output—developing income-generating alternatives to oil revenues often means incursion into forests or other areas that are rich in biodiversity.*

*Some countries have taken positive steps toward conserving the rich biodiversity in the region, but such measures may not be sufficient in light of economic development interests—despite some historic steps toward conserving natural resources in the Congo Basin Region, failure to uphold legislation and limited monitoring could threaten to impinge on these measures.*

*Mineral extraction has contributed to violent conflict, and most of the countries in the region lack the political will or resources to ensure compliance with national and international norms and regulations—conflicts have been fueled by access to revenues from mineral resources, encouraging corruption, harmful environmental practices, and neglect of basic human rights.*

**1. The Congo Basin Region (CBR).** The CBR hosts one of the world's largest expanses of closed canopy tropical forest, second in area only to the Amazonian rainforest. Encompassing an area of more than 700,000 square miles in six different countries, the forests of this region include 10,000 species of plants, 1,000 species of birds, and 400 species of mammals. The countries of the CBR—Cameroon, the Central African Republic (CAR), the Republic of Congo (the RoC), the Democratic Republic of Congo (the DRC), Equatorial Guinea, and Gabon—are home to a wealth of mineral resources, including oil, diamonds, gold, copper, manganese, and uranium. Mineral resources have provided significant revenues for the respective countries of the CBR. Yet each country has developed distinct political, social, economic, and environmental features relative to the unique circumstances and resources within its borders.

Balancing exploitation of the region's considerable natural resource wealth and conserving its biodiversity remains a significant challenge for all countries in this region. Many of the resources that come from the CBR are in high demand around the world, and mining is critical to many of these economies. Development of these high-value resources, however, has fueled social disruptions and undermined the stability of the region, as well as contributed to environmental degradation of valuable ecosystems.

**1.1 Purpose of the mining sector assessment:** This desk study looks primarily at the mining industries in the nations of the CBR and peripherally at infrastructure, logging, and other extractive industries, such as oil as they overlap with mining. The study will assess the role that mining and other extractive industries play in the region's economies and will highlight trends that might inform WWF's conservation priorities in the region, which are based on the evolving development needs and challenges of the CBR countries. The assessment points to a clear role for WWF in mediating environmental destruction and income generation in the CBR.

This assessment begins with a brief description of country contexts and their mining sectors, followed by a discussion of trends in the region. The discussion of trends includes an overview of the key extractive industry actors, such as companies and governments. The results of a map-based comparison of mining activity and WWF priority ecoregions in the CBR are discussed. The study concludes with major findings based on available literature and results of the map overlays, and recommendations for consideration by the CBR team.

**1.2 Context of Development:** Table 1 provides several social and economic indicators of the CBR countries. Most of the countries in the region rate on the bottom end of the United Nations (UN) Human Development Index. CAR, the DRC, and Cameroon rate among the poorest countries in the region and in the world. Cameroon and the DRC have the highest population density in the region.

**Table 1 - Some Social and Economic Indicators of the Congo Basin**

Country	Surface Area (sq. km)	Population, 2005 (millions)	GDP (US\$)	GDP Growth Rate, 2005	Population Density (persons per sq. km)	Human Development Index Rank** (out of 177)
Cameroon	475,440	16.30	16,985,380,000	3%	34.33	144
Central African Republic	622,980	04.04	1,369,182,592	2%	06.48	172
Congo, Republic of	342,000	03.99	5,090,735,616	9%	11.69	140
Congo, Democratic Republic of	2,344,860	57.55	6,973,684,224	7%	24.54	167
Equatorial Guinea	28,050	00.50	3,230,527,744	10%	17.95	120
Gabon	267,670	01.38	8,055,464,960	2%	05.17	124

Source: World Bank, World Development Indicators 2005.

Note:

\* For 2004.

\*\* UNDP, Human Development Index 2006. The Human Development Index considers dimensions of development such as living a long and healthy life, being educated, and having a decent standard of living. This ranking is given to identify trends in the region.



Each country has evolved distinct political, economic, and social features in response to the natural resource within their respective country. Natural resource rents, especially from oil discoveries, have shifted the public sector priorities of countries like Gabon and Equatorial Guinea. Although both countries are characterized by relatively small populations, oil revenues have caused these governments to shift their focus away from the development of agricultural export markets because capital inflows to the oil sector have diminished the economic need to develop agriculture. In Gabon's case, this shift has contributed to declining deforestation rates, as oil revenues made agricultural exports less competitive, discouraging investment in rural areas and encouraging rural-urban migration. Now facing declining oil reserves, Gabon may confront more pressure to diversify revenue sources, leading to a renewed focus on developing resource reserves.

Cameroon, with a larger population and more diverse geology than Gabon, is also oil rich. In light of this oil wealth, Cameroon could de-emphasize agricultural expansion, especially into the highly forested areas of its southern region. In pursuit of bolstering economic activity, the southern forested regions may be considered prime locations for agricultural and logging expansion. In fact, when oil prices declined in the 1980s, Cameroon shifted its emphasis back to agricultural expansion and incursions were made into forested lands for crop expansion. This might happen again if current oil prices recede, new mineral reserves are not developed to take the place of receding oil revenues, or if government policies fail to encourage sectoral growth in areas with the potential for economic viability.

The RoC and the DRC are struggling with the civil conflicts that have made establishing stable economic policy or sectoral development difficult and erratic at best. Armed groups have used mineral wealth as a source of funding for their activities. The future holds better potential for these two countries only if socioeconomic strife and conflict subside, thus paving the way to resume oil exports and generate revenues for the government from the mineral and logging sectors. Even under a regime of diminished conflict, however, revenues from mining will contribute to sustainable development only if a strong governance system is in place to ensure equitable distribution of benefits and if companies are held accountable for operating in a socially and environmentally responsible manner.

Striking a balance between development and conservation is a fundamental challenge to progress in the CBR. Mineral extraction is not the only threat to forests in terms of deforestation. Agricultural expansion is also a major contributor to deforestation and, at times, has a greater effect than mineral extraction. The revenues to be gained from exploiting mineral reserves, particularly oil, might instead decrease deforestation in some countries by reducing the pressure for agricultural

expansion. If, however, profits from oil development are reinvested in policies and instruments that encourage agricultural expansion, deforestation can result, as was the case in Cameroon<sup>1</sup>. Sven Wunder detailed this phenomenon in a study of eight tropical countries with major oil wealth.

Although the forest and river networks that have been deemed priority areas by WWF extend into all the CBR countries, not all of these countries are examined in depth in this assessment. The accounts given emphasize the areas of "priority" and, from a conservation perspective, hold more potential for near-term engagement. Specific regions within countries are emphasized as priority areas of action, because of the overlap between mining activity and WWF conservation priorities in the region.

Infrastructure development presents an additional threat to forests and freshwater ecosystems, not only through the permanent loss of wildlife but arguably even more through physical incursion into forests and the disruptions to wildlife habitats. Infrastructure development in the CBR, outside of urban centers, has been partially linked to the agriculture, mining, or logging industries. Direct impacts from mining and logging entail deforestation that encompasses the following: the site covered by roads, mines, excavated minerals and earth, equipment, and settlements associated with the mining or logging activities. The area deforested may be limited, encompassing less than 1 percent of total forested area in a given country, and may regenerate if left alone. Indirect impacts from mining or logging can pose a greater threat to habitat degradation. Bushmeat hunting is a serious threat to wildlife and contributor to resource degradation in areas that have been opened to extractive practices, oil and other mineral development, or logging.

**2. Current Trends and Vulnerabilities.** The high price of many minerals is helping to reverse the lack of viability of many deposits. A growing trend toward companies offering to build the necessary infrastructure has taken the burden off host countries with already-limited infrastructure investment to pour much-needed funds into development used primarily for mining. The quest for export diversification in the respective economies has encouraged mineral resource exploitation.

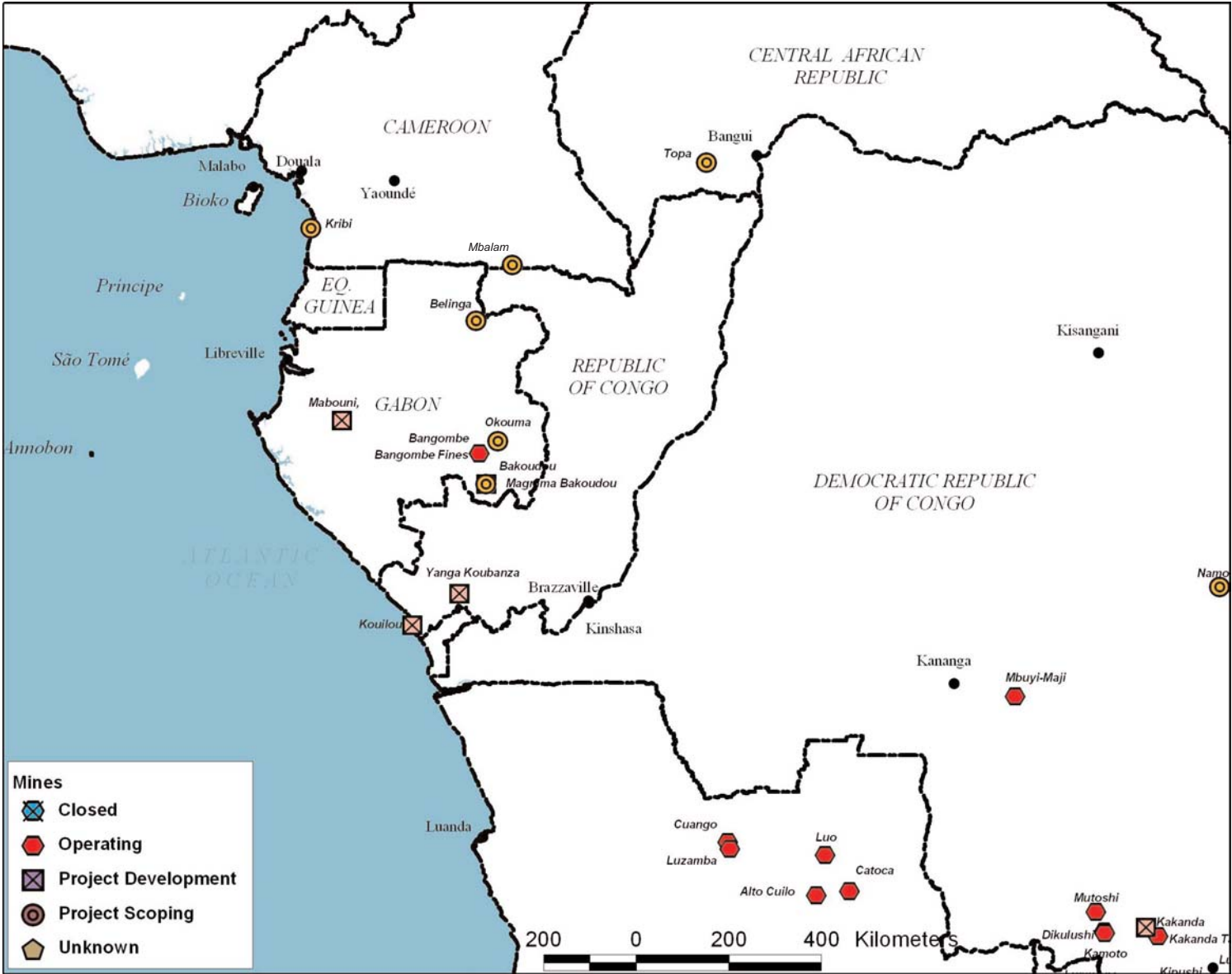
Currently, many mining operations in Gabon and Cameroon take place in savannah areas; however, new developments are more likely to encroach on the dense forests of these countries (the country descriptions give more detail). Mining in the DRC has been limited largely to the fringes of the river and forest systems that make access difficult. The RoC has several projects, and mineral reserves that have been put "on hold" because of unstable political and social conditions could be encouraged for future development, including necessary infrastructure. Equatorial Guinea appears to have few known

mineral reserves outside of the oil reserves, and CAR could experience an expansion in mining its few known reserves, although investment in infrastructure would be required. The development of infrastructure, or lack thereof, has until now diminished the ability of countries in the CBR to exploit natural resources. Accompanying maps represent the major operating and potential mining sites in the CBR: (1) map 1 illustrates site names; (2) map 2 highlights mineral deposits sites/mine sites and forest density; (3) map 3 highlights freshwater priority areas in relation to mine sites/mineral deposits; (4) map 4 highlights the priority areas in the region in relation to the degree of importance and the relation to mine sites/mineral deposits; and (5) map 5 illustrates important taxa conservation priorities in relation to mine sites/mineral deposits. These sites do not represent a comprehensive list of all mineral deposits in the area; instead, they highlight the most prominent sites that have been identified for development potential. A more comprehensive list of all mineral deposits is provided

by the Secretariat of the African, Caribbean, and Pacific Group of States<sup>2</sup>.

Oil resources in Cameroon and Gabon produced high rents, especially during periods of elevated prices, and fostered distinctive patterns of consumption and spending related to oil rents that filtered through the economy. In both of these countries, oil reserves have been predicted to decline over the coming years (Gabon within the next 30 years without new fields, and Cameroon a continued diminishing output trend without new advances)<sup>3</sup>, which may influence shifting sectoral priorities by encouraging development of other high-value resources, such as minerals. Officials in Gabon have acknowledged the dwindling known reserves of oil and are working to develop alternatives to maintain rents. One alternative has been to establish a comprehensive national park system. Other options include the allocation of oil exploration rights in an established national park, as well as the allocation of exploitation rights for an iron-ore mine and accompanying infrastructure.

Map 1: Site Names and Locations





Map 2: Mineral Deposits Sites/ Mine Sites and Forest Density

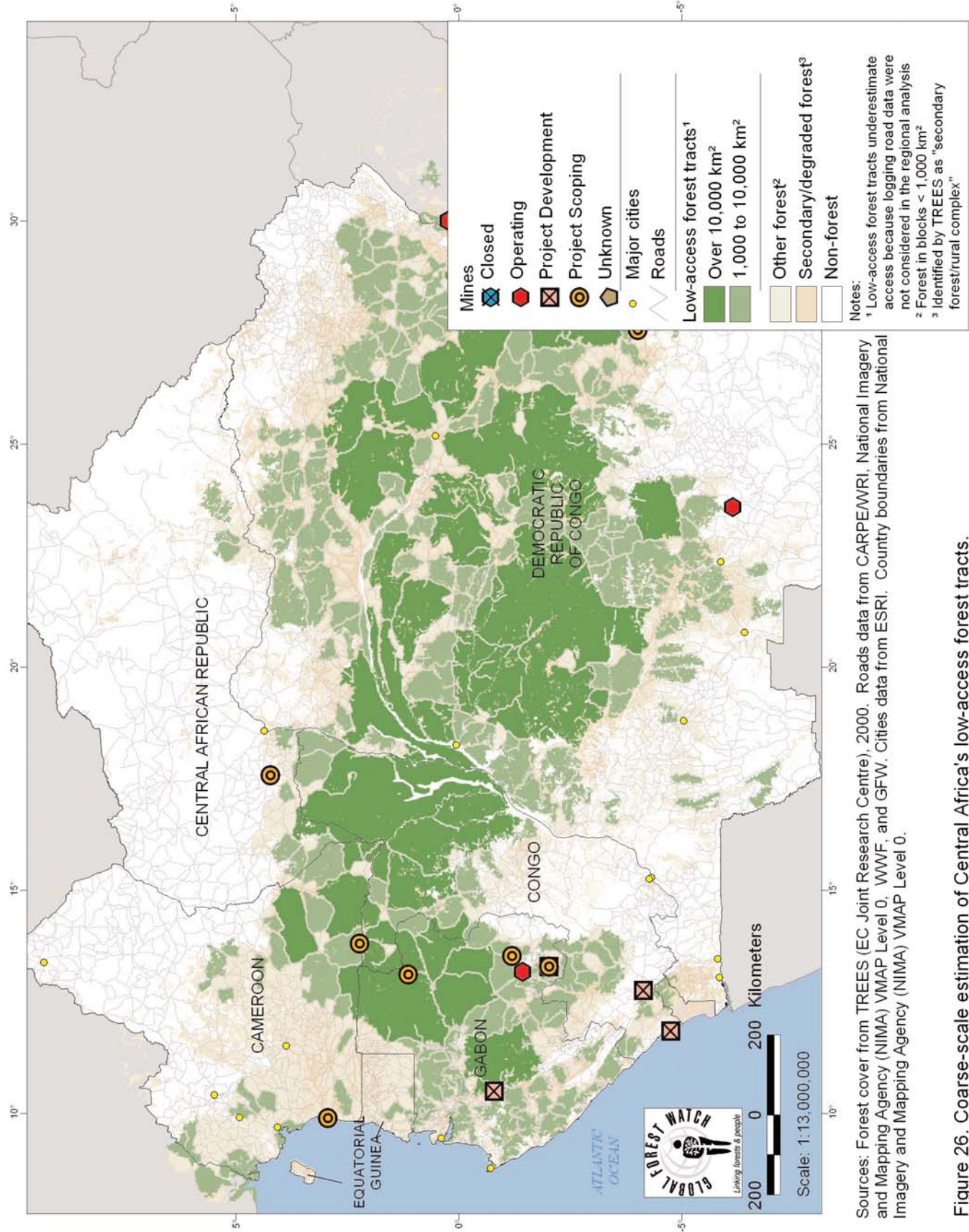
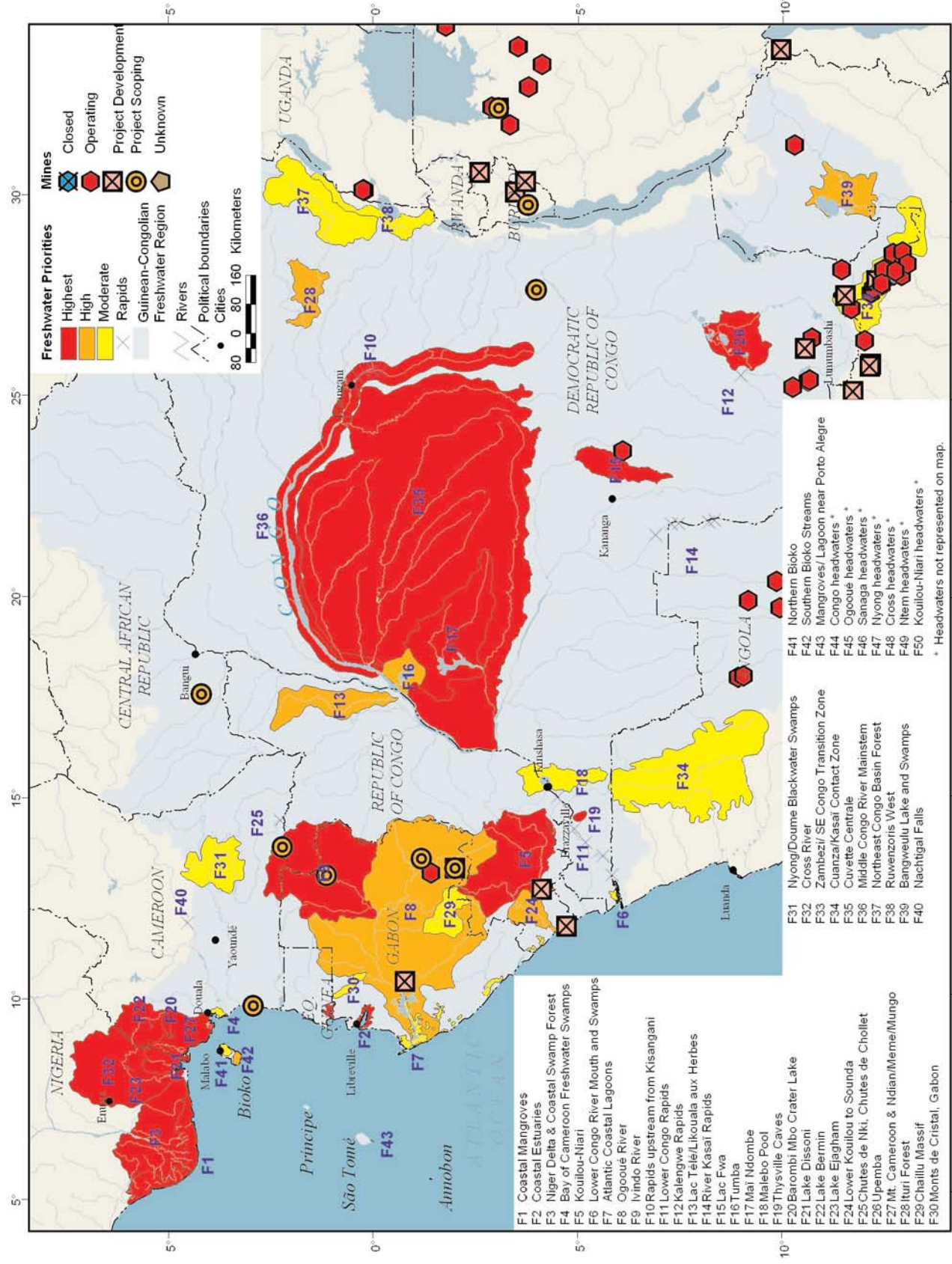


Figure 26. Coarse-scale estimation of Central Africa's low-access forest tracts.



Map 3: Freshwater Priority Area and Mine Sites/ Mineral Deposits



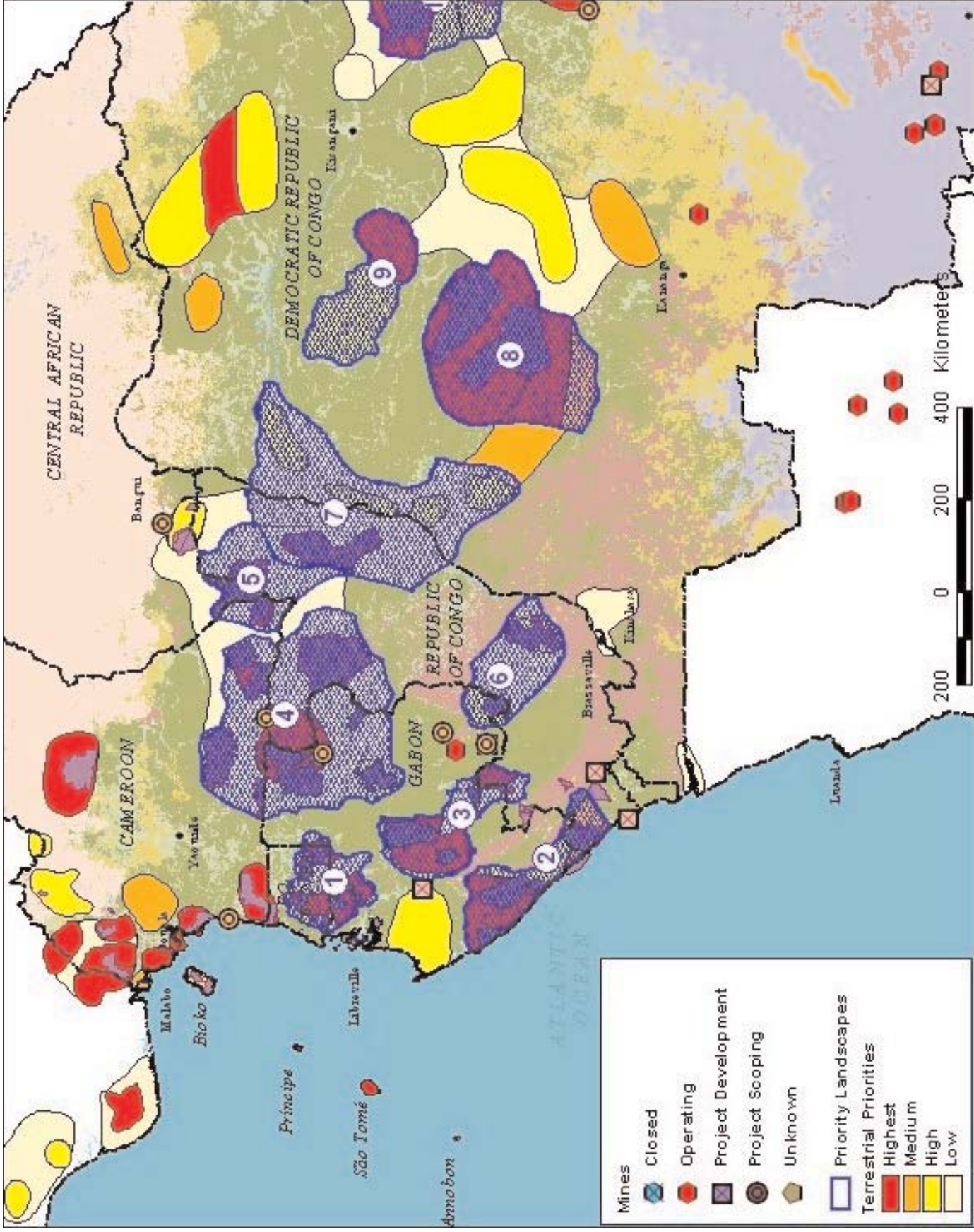
Baseline data: ESRI, 1993. Digital Chart of the World. Environmental Systems Research Institute, Redlands, CA

Figure 4. Freshwater priorities for conservation action.



The map displays the geographical distribution of mining activities and priority landscapes in Central Africa. Key features include:

- Geographical Labels:** Central African Republic, Democratic Republic of Congo, Gabon, Cameroon, Atlantic Ocean, and various islands (Príncipe, São Tomé, Annobon, Malabo, Bioko, Yeu, Yeu, Yeu).
- Numbered Regions:** Nine regions are numbered 1 through 9, each with a unique color and pattern.
- Mine Status Legend:**
  - Closed: Blue circle with a cross
  - Operating: Red circle
  - Project Development: Purple circle
  - Project Scoping: Green circle
  - Unknown: Brown circle
- Priority Landscapes Legend:**
  - Highest: Red
  - Medium: Orange
  - High: Yellow
  - Low: Light Yellow
- Scale:** A scale bar indicates distances of 200, 0, 200, and 400 Kilometers.





Map 5: Important taxa conservation priorities and mine sites/mineral deposits

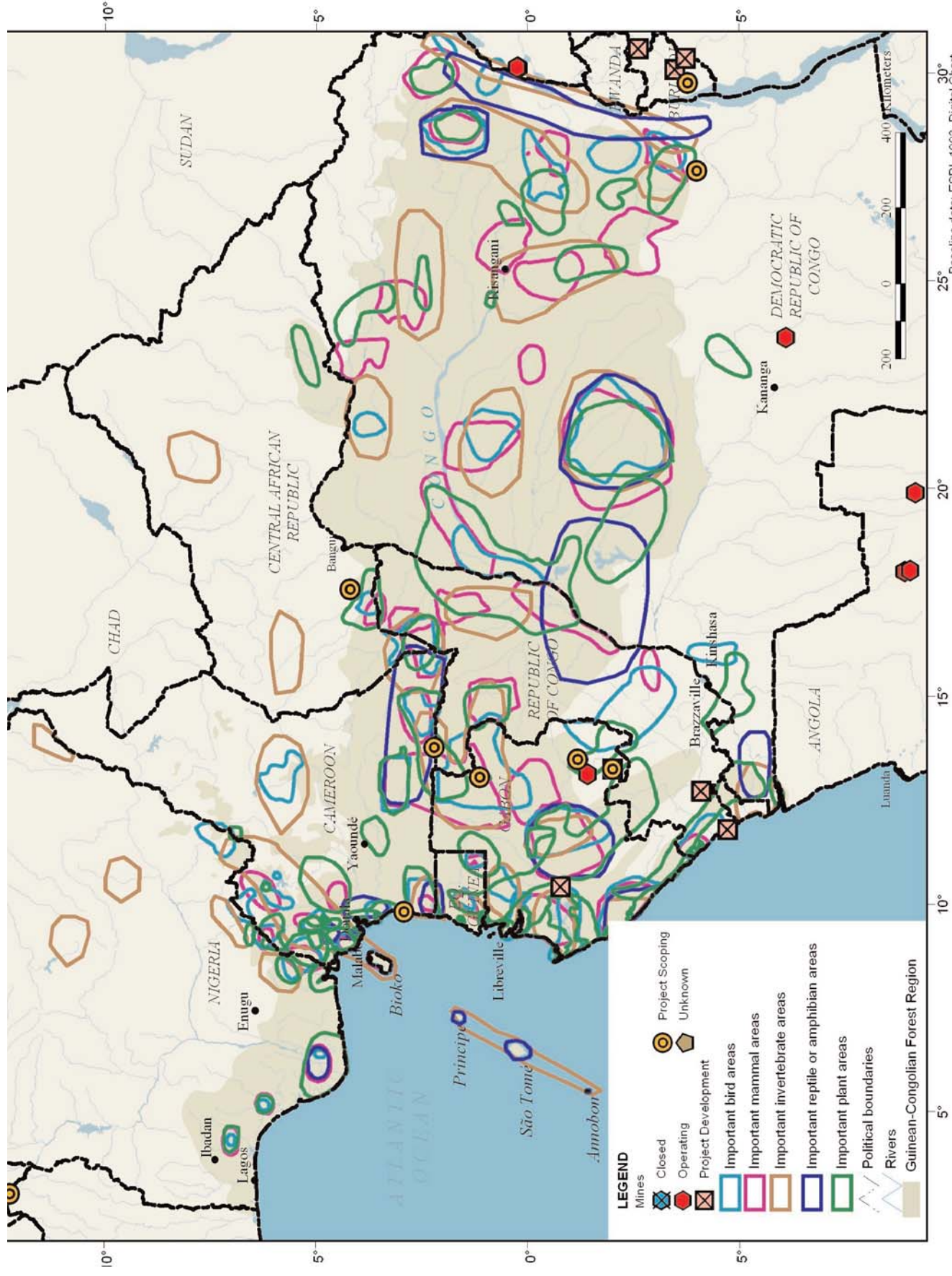


Figure 15. Distribution of estimated important areas for all taxa.

Baseline data: ESRI, 1993. Digital Chart of the World. Environmental Systems Research Institute, Redlands, CA

Many private firms are reaching out to the Congo Basin to sign contracts that cover infrastructure development in WWF priority areas. In Gabon, one of the largest known reserves of iron ore recently has been put under contract for development by China National Machinery and Equipment Import and Export Corporation (CMEC), which includes building the related infrastructure. News reports indicate that a separate Australian company (Sundance) has been allotted exploration rights in Cameroon<sup>4</sup> that would—should the project be approved—involve the development of an iron-ore mine and the related infrastructure, which also falls within the dense tropical forests that cover the southern portion of Cameroon. This project would include the development of a railway to transport the ore, although it is yet unspecified whether the new railway will connect to Douala, or another Cameroonian port city, or combine with the iron-ore project in Gabon. These individual mining and infrastructure projects can have adverse impacts on forest and freshwater systems, but the significantly negative impact can be mitigated through the use and enforcement of eco-friendly practices. Exacerbating the potential for serious impact is the degree to which the two projects will require significant infrastructure development, including railways, roads, and—in the case of Gabon—a hydroelectric dam and deepwater port.

High rents from minerals development increases investment in those sectors of high return, decreases the competitiveness of nonmineral products, and reduces incentives for expanding nonmineral sectors (see the following section on world mineral trends). Logging is prominent in the countries of the CBR (notably Cameroon and Gabon, as well as others). Pressure to

expand logging may further increase with declining rents from minerals and as higher-value species are exhausted. Previously less economically viable species tend to be harvested, as has been demonstrated in Cameroon and Gabon. The growth and development of these varying activities (such as mining, logging, and cocoa production) can have unintended consequences by making previously remote and intact forests accessible for colonization.

The main minerals outside of petroleum found in the countries of the Congo Basin are listed in table 3. A development plan based on revenue from these extractive sectors entails high risks, however, because these commodities are subject to price vulnerabilities and fluctuations on the international market.

Table 2 shows the top export commodities in the CBR. Minerals and fuels rank in the top of each country's export earnings. This is due in part to the revenues from oil as well as minerals. In the DRC, precious gems (primarily diamonds) are the dominant export earner as the petroleum sector has suffered and degenerated from many years of civil conflict. The export earnings from gems may actually be much higher because illegal markets and trade are not incorporated into these statistics. As an example of the lack of formal control and market degeneration, the International Monetary Fund (IMF) estimated that, in 2004, artisanal diamond production reached 22.1 million carats compared with only 8.8 million carats by formal industrial miners<sup>5</sup>. The instability in the DRC and the RoC has led to tenuous political, social, and economic conditions that have disrupted many of the established extractive practices.

**Table 2 - Export of Selected Goods as Percentage of Total Exports**

2004 Country Data	Export as a Share of Total Exports (%)	Rank Export in Country	Export value in U.S. dollars (thousands)
Cameroon—Mineral fuels, oils, distillation products	50.76	1	1,619,986
Cameroon—Wood and articles of wood, wood charcoal	19.50	2	622,214
Central African Republic—Mineral fuels, oils, distillation products	—	—*	—
Central African Republic—Wood and articles of wood, wood charcoal	38.319	2	50,950
RoC—Mineral fuels, oils, distillation products	85.682	1	3,469,695
RoC—Wood and articles of wood, wood charcoal	7.387	2	298,491
DRC—Mineral fuels, oils, distillation products	8.915	4**	107,337
DRC—Wood and articles of wood, wood charcoal	4.663	5**	56,148
Equatorial Guinea—Mineral fuels, oils, distillation products	93.349	2	3,964,311
Equatorial Guinea—Wood and articles of wood, wood charcoal	2.604	3***	110,577
Gabon—Mineral fuels, oils, distillation products	76.184	1	2,117,897
Gabon—Wood and articles of wood, wood charcoal	13.393	2	372,328

Source: UNCTAD/WTO International Trade Center.

Note:

\* Number one is pearls, precious stones, metal coins, and so on (46.232%). CAR is not an oil-exporting country.

\*\* Number one is pearls, precious stones, metal coins, and so on (46.297%); number two is ore slag and ash (23.691%); and number three is other base metals and articles thereof (11.956%).

\*\*\* Number two is organic chemicals (3.184%).



**Table 3 - Common Minerals in Congo Basin Countries**

Mineral	Commodity Use	Country Deposit*
Gold	Ornamental, electronics, dentistry, decorative plating of jewelry, watchcases, pens and pencils, spectacle frames and bathroom fittings, decoration of china and glass, store of value	Equatorial Guinea, Gabon, RoC, DRC, CAR, Cameroon
Diamonds	Jewelry, industrial fittings, machinery	Gabon, RoC, DRC, CAR, Cameroon
Iron	Steel making, alloy	Gabon, RoC, DRC, Cameroon
Uranium	Nuclear fuel, nuclear weapons, X-ray targets, photographic toner	Gabon, RoC, DRC
Lead	Batteries, cable sheathing, lead crystal, solder and radiation protection, anti-knock compound in petrol, plumbing, ammunition	Gabon, RoC, DRC
Tin	Tinplates, alloys, solder, pewter, chemicals, panel lighting, frost-free windshields	RoC, DRC, Cameroon
Aluminum	Aircraft parts, automotive parts, railroad cars, seagoing vessels, packaging, building construction, electrical applications, pharmaceutical uses, water treatment	RoC, DRC, Cameroon
Manganese	Steel making, alloys, batteries, colorants and pigments, ferrites, welding fluxes, agriculture, water treatment, hydrometallurgy, fuel additives, oxidizing agents, odor control, catalysts, sealants, metal coating, circuit boards	Gabon, DRC
Copper	Building construction, aircraft parts, automotive parts, industrial applications and machinery, furniture, coins, crafts, clothing, jewelry, artwork, musical instruments, cookware	RoC, DRC
Titanium	Lightweight alloys, aircraft components, automotive components, joint replacement (hip and ball sockets), paints, watches, chemical processing equipment, marine equipment (and other parts exposed to sea water), pulp and paper processing equipment, pipes, jewelry	RoC, Cameroon
Cobalt	Super alloy in jet and gas turbine engines, magnets, stainless steel, electroplating, batteries, cemented carbides and diamond tools, catalysts, pigments, radio therapeutic agents	DRC, Cameroon
Niobium	Alloys, stainless steel, corrosion-resistant alloys, gas turbines, rocket engines, plating, coins, catalysts, burglar-proof vaults, batteries	Gabon

Source: International Institute for Environment and Development and World Business Council for Sustainable Development, Breaking New Ground, London: Earthscan: 2002, 51–52<sup>6</sup>.

Note: CAR = Central African Republic; DRC = the Democratic Republic of Congo; RoC = the Republic of Congo.

Note: Other minerals present: Phosphate, zinc, palladium, wolfram, sapphire, feldspar, barite, marble, lithium, gabbro and tantalum, potash

\* According to lists from the Secretariat of African, Caribbean and Pacific Group of States Mining Data Bank, [http://mines.acp.int/html/pays\\_en.html](http://mines.acp.int/html/pays_en.html) (accessed December 1, 2006).<sup>7</sup>

**2.1 Global Metals Trends:** Oil prices reached record highs in 2006, resulting in increased incentives to exploit mineral resources in the CBR. Oil prices rose to \$78 per barrel in July<sup>8</sup>, and prices of other minerals (such as silver, copper, and zinc<sup>9</sup>) have risen sharply. Uranium prices have tripled in recent years<sup>10</sup>. Consequently, reserves that once seemed unviable are now receiving added scrutiny because of high prices and high demand (especially from China).

The price of many major metals has experienced near-record highs in recent years. This past year, gold surpassed \$700 per ounce and other precious and base metals also set record highs. Demand for metals in China and India has fueled increased production for such base metals as iron ore, copper, cobalt, and bauxite. As a result, exploration budgets of mining companies have increased in recent years.

According to a report by the Metals Economics Group, global exploration budgets reached \$5.1 billion in 2005, which was just shy of the record set in 1997. The largest proportion of exploration dollars was spent in Latin America, particularly Mexico and Peru.

Companies continued to demonstrate considerable interest in deposits in Russia, China, Mongolia, Angola, the DRC, and Gabon. Relatively few major mining projects are in the industry's existing pipeline for short-term development. The lack of available mined resources coupled with long-term growth projections for China means that demand will likely outstrip existing supply. Under this scenario, pressure will increase to find and develop deposits that previously were not attractive because of political instability, low access, or marginal ore grades<sup>11</sup>.

**Select Metals Production:** Data for metals production in Central African countries are unreliable, but it appears that some countries have rapidly expanded their production of major metals between 2000 and 2004. During that time period, production of gold expanded by a factor of eight in the DRC (Kinshasa) and increased by 50 percent in Cameroon (see figure 1).

Alluvial diamond deposits are abundant in the DRC. Demand for diamonds is increasing, especially in China, where the country's burgeoning middle class is increasingly purchasing luxury items, such as diamond jewelry. The growth in diamond luxury items is increasing by 20 percent per year in China, far outpacing strong growth of diamond sales in the United States<sup>12</sup>.

Iron ore is the basic raw material from which iron and steel are derived and, therefore, is a critical material for all industrial economies. Global trends in iron-ore consumption indicate that world demand will continue to be driven

by Chinese demand for raw materials. From 1996 to 2004, Chinese consumption of iron ore increased by 135 percent. Increasingly, Chinese interests are entering into overseas joint-venture partnerships that allow it to identify and access iron-

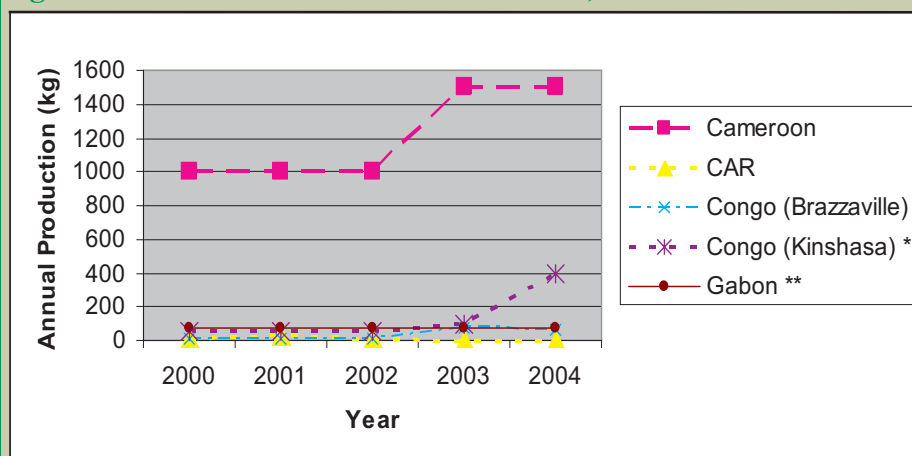
ore reserves to satisfy its demand. Supplies of iron ore are predicted to remain "tight" through the coming years<sup>13</sup>. Brazilian iron-ore mining giant Companhia Vale do Rio Doce (CVRD) increased shipments of iron ore to China by 40 percent over the last year<sup>14</sup>.

Like iron ore, manganese is used in the production of iron and steel. Global manganese-ore production rose by 9 percent from 2003 to 2004, and China was the leading producer. Gabon is among the world's top 10 manganese-ore producers, and outputs of manganese ore rose by more than 40 percent from 2000 to 2004. Manganese-ore production will likely follow the demand for iron ore in coming years, with Chinese demand outstripping most other consuming countries<sup>15</sup>.

Columbium and tantalum (coltan) are used in the production of steel for alloys, aircraft engines, and electronic devices (for example, digital cameras, cellular phones, laptops, video phones). Global consumption of tantalum for these devices is expected to grow by 7 percent per year. Australia and Brazil supply most of the coltan ores, but other significant production comes from the DRC, Rwanda, and Uganda. From 2000

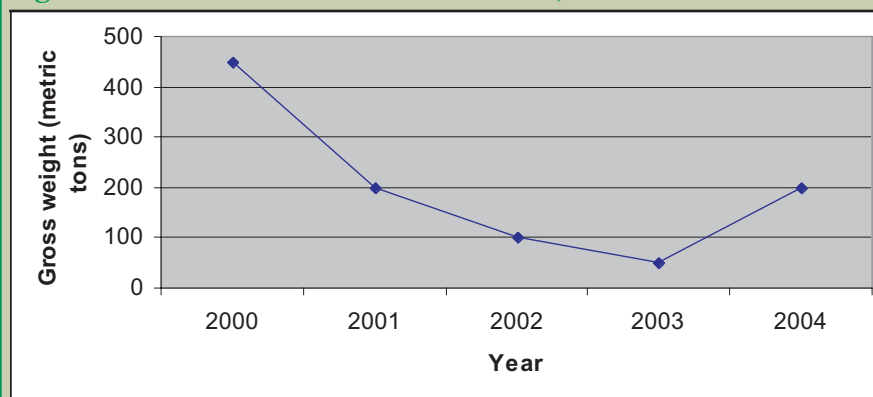
to 2004, gross weight production of coltan in the DRC decreased by more than 50 percent, but production appears to be on the rise, possibly because of the end of civil war in that country (see figure 2).

**Figure 1. Central African Gold Production, 2000–04**



Source: USGS, Mineral Commodity Summaries, "Gold," 2005.

**Figure 2. Coltan Production in the DRC, 2000–04**



Source: USGS, Mineral Commodity Summaries "Columbium and Tantalum," 2004.

**2.2 Infrastructure Development:** Many of the countries in the CBR have relatively weak infrastructural network systems. Development agendas are likely to focus on improving transportation and inland access to facilitate trade and other economic activities. In many cases, mining, logging, and agriculture require significant infrastructure to transport products from production sites to shipping centers and then to final destinations. In Gabon, logging has not contributed significantly to road building because many logs are moved via river systems. Cameroon's geographic limitations (fewer navigable rivers) have required the development of roads and railroads as an integral part of logging. National policies and trends partly dictate the extent to which deforestation has taken place and which sectors will be expanded further.

Lending institutions play a significant role in infrastructure development in terms of identifying lending and sectoral priorities. The World Bank is pursuing a Regional Integration Assistance Strategy (RIAS) for Central Africa for fiscal years 2003 to 2008. The regional strategy covers Cameroon, CAR, the RoC, Gabon, Equatorial Guinea, and Chad, and identifies priority areas to enhance regional development. Transport and trade facilitation are the core activities identified for World Bank lending; regional road links are the primary intended means to enhance transportation. It is unclear what approach the Bank will take when faced with large dense forests that may be an impediment to road construction; however, it is likely that roads will cut through forests at some locations<sup>16</sup>.

Road, railroad, or other transport means may involve incursions into forested areas, especially in countries with high forest coverage, such as Gabon. Table 4 shows the forest cover in each country and highlights forest cover in the CBR. Other nontransport infrastructure activities in telecommunications and energy sectors fall into the lending priorities of the IMF, European Union (EU), African Development Bank (AfDB), and France.

Infrastructure investments in roads have been at the forefront of development projects in Cameroon, while the RoC has emphasized railroads in addition to roads; harbor improvement at Pointe Noire, Brazzaville, Makotipoko, and Massaka; and improved energy access throughout the country. In total 38.19 percent of the investment budget is earmarked for infrastructure development in the RoC for 2007<sup>17</sup>. In Gabon, some lending, primarily from the EU, would focus on infrastructure and transportation development in combination with domestic policies for expanding trade that enables development. There is little or no Multilateral Development Bank (MDB) activity in Equatorial Guinea or CAR, because management and other internal issues of instability have made investment tenuous. Engagement in the DRC has been centered on relieving crisis situations and improving sectoral conditions in mining and forestry to foster reengagement and reinvestment, especially from private sector sources. The development of Mining and Forestry Codes by the World Bank and the restructuring of the financial sector in coordination with the IMF are targeted at promoting programs that attract investment through fair and transparent processes. Assisting with coherent legislative and economic reforms, such as the design of a new commercial court, new investment codes and new mining and forestry codes have been part of the World Bank's rehabilitation focus in the DRC. These activities include providing support to the parastatal structure, including the state-owned mining company, La Générale des Carrières et des Mines (Gécamines), and rehabilitating infrastructure such as the Inga dam hydroelectric system.

The Inga dams (Inga I, Inga II, the proposed Inga III and Grand Inga) rank among the highest-profile development projects in the region. The Grand Inga project has been proposed, although not widely accepted, as a potential building block for a trans-African electricity grid with an estimated generation output of 39,000 megawatts—nearly twice as much as the Three Gorges Dam in China—at an estimated cost of \$6 billion<sup>18</sup>. The development of Inga III and Grand Inga are not

**Table 4 - Forest Cover by Country**

Country	Total Country Area (sq. km)*	Forest Area, 2000 (sq. km)	Forest Area, 2005 (sq. km)	Forest Area (% change)**
Cameroon	475,440	223,450	212,450	4.92
Central African Republic	622,984	229,030	227,550	1.65
Congo, Republic of	342,000	225,560	224,710	0.38
Congo, Democratic Republic of	2,345,410	1,352,070	1,336,100	1.18
Equatorial Guinea	28,051	17,080	16,320	4.45
Gabon	267,667	218,260	217,750	0.23

Source: World Bank, World Development Indicators 2005.

Note:

\* CIA World Fact Book [year].

\*\* Authors' calculation based on World Bank and CIA data.



yet under way, although steps have been taken to move forward with their development. The Canadian International Development Agency (CIDA) is reportedly funding a feasibility study for Inga III, and there is increasing pressure to skip Inga III and move straight into the development of the Grand Inga Dam. Rehabilitation of turbines at Inga I and Inga II will likely receive partial funding through World Bank loans, and a loan for repairs on Inga II will be considered in 2007. Remaining repairs on Inga II will be funded by a subsidiary of the Canadian firm MagIndustries, in exchange for guaranteed power of its operations at Pointe Noire in the RoC<sup>19</sup>.

Another significant infrastructure development is the construction of the Chad-Cameroon oil pipeline. The pipeline is the largest private sector investment in sub-Saharan Africa and is expected to cost US\$4.1 billion, of which the World Bank Group will provide approximately US\$200 million. The pipeline was approved by the World Bank in 2000 and should bring transit fees and revenues to Cameroon. According to World Bank estimates, the underground pipeline will cause little resettlement, will produce minimal deforestation of tropical forest (10 to 15 square kilometers), and will adhere to appropriate standards of environmental protection<sup>20</sup>.

Several prominent public-private partnerships or private concession projects related to infrastructure development signal a trend of partial privatization in several countries:

#### Cameroon

- A 20-year concession for operating the national railways shared by the government (15%), Saga and Comazar (splitting 51%), and investors (34%), which was awarded in 1998
- A 20-year concession for US\$285 million shared by Ondeo/Suez (51%) and the Cameroon government water utility Société Nationale des Eaux, which was awarded in 2000

#### Central African Republic

- A concession awarded in 1991 to SODECA: SAUR (Bouygues) to provide water services to all urban areas serving a population of 1.1 million for 15 years

#### Gabon

- A 20-year concession awarded in 1999 for US\$102.6 million to Transgabonais-Transurb Consult (partially owned by SNCB and the Brussels transportation authority) to operate the Trans-Gabon railway with some maintenance by the Gabonese government
- Studies for a US\$11.5 million project that would privatize the oil and port city of Gabon (Port-Gentil), including a dry-dock facility
- A US\$94.5 million concession with the Société d'Electricité et d'Eaux du Gabon (SEEG) awarded to Vivendi to provide water and electricity to the cities of Libreville, Port-Gentil, and Franceville<sup>21</sup>.

Road building is the primary infrastructure development associated with mines. Road development and the associated traffic create noise pollution, can cut into natural habitat, and constrain wildlife movement. Road development is part of broader regional development plans for interconnection, reinforcing policies that cut into forested and other previously untouched areas. Access into newly developed areas promotes the bushmeat trade and increases pressure on animal habitats. Other mining-related infrastructure can be equally harmful to surrounding areas as miners set up camps producing associated waste and pollution that can run untreated and unmonitored into the surrounding habitats.

Mining projects can include the areas where minerals are recovered from the ground (larger in certain instances such as open-pit mining), numerous vehicles, testing sites, and also roads and railways to move the targeted mineral and waste material. The deleterious effects of infrastructure development in the CBR are exacerbated because these sites are located in previously undeveloped areas or in areas that have high biological importance. Infrastructure development can be done in a number of ways, and although assessments of one particular project may indicate a limited impact, such projects should be viewed within the broader context of regional infrastructure development because the cumulative effects of such development are likely significant. Expansive networks of roads and railways can cut off the natural migratory and dispersal patterns of animal movement and can expose these animals to pollution and hunters.

**2.3 Environmental Impacts:** Habitat destruction is the most significant cause of biodiversity loss, because removal of vegetation alters the availability of food and shelter for wildlife. Mining and logging may affect biodiversity by changing species composition and structure, particularly in protected areas or areas that are not formally protected but that contain a high level of species biodiversity. Management or capacity may be poor or inadequate to regulate mining and logging activities even in protected areas.

*Damage from Mining Practices:* More than one-quarter of the world's active mines and exploration sites overlap with or are situated within a 10-kilometer radius of a strictly protected area. Nearly one-third of all active mines and exploration sites are located within areas of intact ecosystems of high conservation value. Almost one-third of all active mines are located in stressed watersheds. To date, mining has a poor record in terms of its contribution to sustainable development, with few communities receiving significant benefit and mining sites experiencing lasting negative ramifications. Nearly three-quarters of active mining and exploratory sites overlap with areas of high conservation value and areas of high watershed stress. Many mineral-dependent countries in the developing world lack important safeguards and government

oversight, and under these conditions, increased investment in mining will not contribute positively to economic development<sup>22</sup>.

Key environmental and social impacts of mining include ineffective waste management in the extraction, processing, and transport of metals and minerals. Ineffective waste management can result in the sedimentation of materials into waterways with deleterious effects on fish and aquatic life. Acid drainage is a particularly severe toxic condition in which metals are dissolved in water, killing flora and fauna. Acid drainage presents a risk with sulfide-bearing ore bodies and, once it occurs, water treatment (often over many decades) is the only remedy. Other adverse social impacts of mining include the uneven creation and distribution of wealth from mining activities, competition for natural resources, increased

wildlife trade, prostitution, displacement of people, alcoholism, and conflict<sup>23</sup>. Table 5 presents a detailed list of potential impacts from mining activities.

Mining's threat to waterways is particularly tenacious because of the high demand for water in the processing of minerals, a situation that can create runoff that is easily filtered back into the natural water system. The nature of mining involves the use of several toxic processing materials (for example, cyanide) that have serious hazardous implications for wildlife and can completely decimate natural life. Mining can alter and disrupt surface water and groundwater flows, causing toxicity or interrupting and altering water flows<sup>24</sup>. Watershed degradation can have far-reaching implications because mine waste can travel downstream, thus affecting spawning areas or travel corridors for aquatic life. Although mine waste can be

**Table 4 - Potential Environmental and Social Impacts of Mining**

Stage	Activities	Potential Impacts
Exploration	<ul style="list-style-type: none"> <li>• Geophysical/aiborne surveying</li> <li>• Drilling/trenching</li> <li>• Trench blasting</li> <li>• Exploration camp development</li> <li>• Road construction</li> </ul>	<ul style="list-style-type: none"> <li>• Habitat loss/fragmentation</li> <li>• Runoff sediments/increased suspended sediment load to surface water</li> <li>• Disturbance to wildlife and local communities</li> <li>• Increased demand for local water resources</li> <li>• Spills of fuels and other contaminants</li> <li>• Increased colonization due to road development</li> <li>• Species loss due to hunting</li> </ul>
Site Preperation/ Mineral Extraction	<ul style="list-style-type: none"> <li>• Mine construction (vegetation removal stripping)</li> <li>• Mine infrastructure development (power lines, roads, etc.)</li> <li>• Construction of plants, offices, buildings</li> <li>• Mine camp construction</li> <li>• Creation of waste rock piles</li> <li>• Creation of low- and high-grade ore stockpiles</li> <li>• Blasting to release ore</li> <li>• Transport of ore to crushers for processing</li> </ul>	<ul style="list-style-type: none"> <li>• Habitat loss/fragmentation</li> <li>• Chemical contamination of surface water and groundwater</li> <li>• Declining species populations</li> <li>• Toxicity impacts to organisms (terrestrial and acquatic plants and animals)</li> <li>• Altered landscapes</li> <li>• Increased demand for water resources</li> <li>• Increased demand for electrical power</li> <li>• Increased erosion and siltation</li> <li>• Altered patterns of drainage and run off</li> <li>• Dust/fumes from explosives</li> <li>• Increased colonization due to road development</li> <li>• Species loss due to hunting</li> </ul>
Processing/ Smelting	<ul style="list-style-type: none"> <li>• Milling/grinding ore</li> <li>• Chemical leaching/concentration of ore</li> <li>• Smelting/refining ore</li> </ul>	<ul style="list-style-type: none"> <li>• Dischance of chemicals and other wastes to surface waters</li> <li>• Emissions of sulfur dioxide and heavy metals</li> <li>• Increased demand for electrical power</li> </ul>
Transport to Final Markets	<ul style="list-style-type: none"> <li>• Packaging/loading of final product</li> <li>• Transport of product</li> </ul>	<ul style="list-style-type: none"> <li>• Noise disturbances</li> <li>• Dust/fumes from stockpiles</li> </ul>
Mine Closure/ Postoperation	<ul style="list-style-type: none"> <li>• Reseeding/revegetation</li> <li>• Recontouring</li> <li>• Fencing dangerous areas</li> <li>• Monitoring seepage</li> </ul>	<ul style="list-style-type: none"> <li>• Persistent contamination in surface water and groundwater</li> <li>• Expensive, long-term water treatment</li> <li>• Persistent toxicity to organisms</li> <li>• Loss of original vegetation/biodiversity</li> <li>• Abandoned piles/shafts that pose hazards and health risks to humans</li> <li>• Windborne dust</li> </ul>

Source: Miranda, et al. Mining and Critical Ecosystems: Mapping the Risks (Washington, DC: World Resources Institute, 2003), taken from Miranda, et al. 1998 and Ashton, et al. 2002.

put back into the excavated hole, it almost never is, because open-pit mines can cover a tremendous area, potentially several miles wide<sup>25</sup>. Maps 1 through 5 illustrate how harmful mining practices can affect the sensitive ecological areas by their proximity and, through the development of infrastructure, potentially extend these impacts past the mine site.

Proactive steps can be taken to limit the damage to surrounding natural areas. Environmental impact assessments before exploration can assist in mitigating potentially harmful repercussions from mining. Without significant monitoring and enforcement, however, this is an unlikely scenario. One indication that environmental policies are unlikely to be implemented to the fullest potential is the exploration practices undertaken by the Chinese oil company Sinopec in Gabon. Although an environmental assessment for the project in Loanga National Park was undertaken, the Chinese company used antiquated methods of seismic testing that can significantly disturb surrounding wildlife. Policies and practices that reduce the negative environmental impacts of mining are crucial because, if left unchecked, the damage to the environment can be substantial and even irreversible.

The following sections provide a more in-depth understanding of the country-specific cases that are part of this assessment. Cameroon and Gabon are given priority in this assessment. These countries are the basis of focus because resource development is under way in these countries with negative potential impacts for conservation initiatives. The circumstance in the DRC is also addressed in some degree of depth. The DRC has remained plagued by civil unrest that has disrupted political, social, economic, and conservation strategies in the country. Pending stabilization in the country, which hopefully will quell some of the tremendous upheaval in the country, the mining and forestry sectors have been identified as important sources of income and rent generation for the government. The disastrous results of mining practices have fueled armed militias and led to many abuses. Revenues and taxes from mineral extraction potentially could be harnessed for the benefit of the economy and country and could be an important focal point of future conservation efforts in the region, if strong governance systems that emphasize transparency, public sector accountability, civil society participation, and judicial redress are established.

CAR and Equatorial Guinea receive less attention in this assessment. The forest and river networks extend only into the southwestern portions of CAR, and the mining sector is relatively undeveloped. Although CAR participates in a multinational conservation effort with its neighbors Cameroon and the RoC in the Trinational Park Project, only one mining site appears to be in proximity to the priority forest and river networks. This is not to suggest little importance of CAR's natural resources, but rather to draw focus to the areas that

seem more threatened. Equatorial Guinea is flush with oil reserves from newly discovered and established oil projects and remains largely closed to outside scrutiny or influence. Equatorial Guinea has few known mineral reserves. Sparse monitoring or openness is allowed, and with reserves deemed to last at least several decades, there is little evidence that scrutiny will encourage better environmental practices.

The RoC has struggled with internal strife and an underdeveloped mining sector. It is possible that with stabilization of its neighbor in the DRC that atmosphere could improve, thus only scant attention will be paid to the RoC.

**3. Country Overviews.** Each country in the CBR faces a distinct set of circumstances and challenges. These countries are mineral-rich, with major deposits in Gabon, Cameroon, the DRC, and the RoC. Despite these rich mineral reserves, civil conflicts have riddled the DRC with instability that has had destabilizing effects in the RoC and CAR, as well as in other countries in the region. In contrast, Gabon and Equatorial Guinea—with their concentration of power in the firm grasps of single leaders—have experienced relative stability, albeit at the expense of a lack of free and fair elections. Reaping the newfound bounties of oil revenues, and record high oil prices, the government of Equatorial Guinea has no apparent reason to increase transparency. Conversely, Gabon and Cameroon are facing declining oil reserves and must reach out to develop other minerals and sectors to fill the revenue gap resulting from the decline of petro-wealth. Gabon and Cameroon appear to be most open to conservation efforts and to have sufficient stability to enact conservation measures. Other countries are suffering from lack of stability, undeveloped internal structures, or closed policies toward external interventions.

**3.1 Cameroon:** Natural resources are an important part of the country's landscape and economy. Cameroon's rich biodiversity includes 900 species of birds, 400 mammals, 1,500 butterflies, 9,000 plants, 210 reptiles, and 200 amphibians. The rich forests are a vital part of the economy, especially in poor rural areas where forest sector employment can account for up to 20 percent of jobs, nationally accounting for 8.9 percent of the gross domestic product (GDP). Cameroon has taken important steps toward protecting its natural resources: approximately 18 percent of national territory has been set aside as national parks (14), wildlife reserves (6), forest management units (110), and wildlife management zones (60)<sup>26</sup>. Despite these initiatives, Cameroon is facing many challenges that threaten its natural resources.



Although Cameroon has active mining prospects, the lack of mining codes may be inhibitive to investment. The Cameroonian mining code is contained in legislation from 1964 regulating mineral substances and in legislation from 1978 outlining taxes, royalties, and mining taxes. In 2001, the law was revised to shift the approval of mining permits from the president to the National Assembly, which provides greater legitimacy and transparency but also more bureaucracy<sup>27</sup>. Petroleum accounts for more than half of the export earnings of the country, around 24 percent of government revenue, and about 6 percent of GDP<sup>28</sup>.

There have been significant efforts on the part of the Cameroonian government to solidify the system of logging concessions and protected areas. Cameroon ranks among the world's top five tropical log exporters, and current logging concessions cover approximately 76 percent of the total forest area (protected and unprotected) in Cameroon. In terms of area, the forests in Cameroon are some of the most species rich in the Congo Basin<sup>29</sup>.

Infrastructure development and the clearing of forested areas could pose the most significant threat to Cameroon's protected areas. Chinese companies have expressed an interest in obtaining exploration and exploitation rights to several bauxite reserves in the far northern portion of the country, at Minim-Martap and Ngouanda, to which the priority forested areas of the Congo Basin do not extend<sup>30</sup>. Bauxite extracted from these mines would be transported to a bauxite smelter currently in operation in Edea. Of greater concern to WWF is an iron-ore deposit near Mbalam, where the Australian mining company Sundance Resources Ltd. has been reportedly moving ahead rapidly with exploration. This development would include infrastructure, such as roads, likely connecting to the city of Lele, and potentially other infrastructure such as railroads toward the coast<sup>31</sup>.

Infrastructure development poses the most significant challenges to Cameroon's forests, which contain some of the most highly diverse ranges of species per area. Road and railroad development could be particularly harmful in Cameroon.

Although individual roads may not seem particularly harmful, they restrict wildlife movement and encourage the use of animals for consumption as well as settlement along the roads and further incursion into forest areas. Cameroonian forests are concentrated in the southern portion of the country, and deforestation concentrated in this area leaves limited habitat alternatives for wildlife. Declining oil reserves in the coming decades will increase pressures to expand alternative sectors, including primarily agriculture and other minerals.

Downturns in global oil markets since the 1980s have resulted in shifts in Cameroon's land use trends. During periods of declining oil prices, urban-rural migration increased significantly, as did logging exports. During oil booms, the inflation of prices caused by inflows of capital, as well as increased urban opportunities associated with oil inflows, affect labor prices and other factors by reducing the competitiveness of the logging and agricultural sectors<sup>32</sup>. In Cameroon, these industries have direct implications for the forested areas that correspond with WWF's priority areas. Decreasing oil flows in the near future could increase the competitiveness of alternative sectors and encourage agricultural expansion into many of Cameroon's fallow fields. Planting practices in Cameroon involve cultivating several fields while allowing others to lie fallow and replenish nutrients. These fields lie fallow for several years while trees and other plants grow, later to be burned or tilled into the soil as part of nutrient replenishment, and other fields are used for current-year crops<sup>33</sup>. These agricultural practices take up considerable space because of the need for numerous fields and areas to be cleared.

The exploitation of minerals in Cameroon, although found partially in forested areas, could potentially replace the wealth from oil and delay pressures to expand agriculture or logging further into forested areas. Higher oil prices seem to coincide with lower rates of deforestation. If true, the same scenario could also occur with mineral development, provided that mining does not open up extensive forested areas and is conducted under the best environmental and social safeguards.

In addition to mineral rights, cocoa has been targeted for potential expansion as part of a concerted effort to increase agricultural production. Cameroon is the world's sixth-largest cocoa producer, and unlike other nearby cocoa-producing countries, such as Ghana and Côte d'Ivoire, Cameroon has not expanded to its full production area or capacity. The areas of relatively unaffected forest encompass thousands of acres and are located in the southern portion of the country. These areas coincide with priority conservation areas and also hold potential for the expansion of other economic activities.

To date, it appears as though cocoa production has been done using relatively environmentally friendly practices, such as agroforestry, in which varying crops are planted, including trees, without completely eliminating native tree species. More than 10 percent of the country's population is reportedly engaged in small-scale labor-intensive cocoa production. The eco-friendly practices have resulted from the uncertainty of cocoa prices. Unstable market prices cause farmers to shift from production of one good to another, depending on which ones allow for more lucrative incomes. When cocoa prices fall, farmers turn to other crops, leaving fields fallow to be cultivated at other times<sup>34</sup>.

Direct concerns related to cocoa expansion are tied to government policies that would encourage urban-rural migration or directly target increased cocoa output. The government has articulated a goal to nearly double cocoa output to 200,000 tons, potentially resulting in the clearing of significant areas of forest cover. Reaching this output would likely require a new focus on promoting cocoa plantations, which could result in clearing substantial tracts of forest compared with the current methods of small-scale production<sup>35</sup>.

Cameroon retains a high potential for logging exports. Expanding logging initiatives include efforts to better map and track forested areas as well as effectively delineate logging concessions. The southeastern area of the country contains the most undeveloped regions, including the Dja Natural Reserve, Nki National Park, and Lobeke National Park (part of the Tri-Sangha Region with the RoC and CAR). Logging and cocoa growth pose similar threats to WWF's conservation priorities—namely, the infrastructure used to access forest areas or transport cocoa makes otherwise inaccessible forested areas accessible for hunting or colonization. The situation in Cameroon is indicative of the broader trend in the CBR, where mineral deposits and economic development plans could include expansion into areas that are now relatively intact forests with high levels of biodiversity.

### Key Players

*Government:* The bodies in charge of regulating the geological and mining sector are (1) the Ministry of Science and Technical Research, which oversees institutes and activities in geology and hydrophysics, hydrology, and energy; and (2) the Ministry of Mines, Water, and Energy, which drives the industrial objectives of the country. The country is undergoing a revision of its Mining Codes to encourage investment and development. An overhaul of the Mining Code and revision of the Petroleum Code began in 1999<sup>36</sup> and was adopted in 2000 and 2001<sup>37</sup>. It is unclear what distinctions are made, if any, among different types of mining companies and what environmental assessments are required.

*Private Sector:* The country's largest company is Alucam, a partnership between private and government ownership. It is in charge of the Edea smelter, which produces 90,000 tons of aluminum from bauxite each year. The iron deposit at Kribi on the western coast is owned by the State of Cameroon and, as of yet, is not being exploited, partially because of its relatively low iron content.

**3.2 Gabon:** Mining and extractive trends in Gabon follow several similar trends to those in Cameroon, with significant infrastructure developments being needed to exploit major mineral deposits, particularly the iron-ore deposit at Belinga. Also similar to the Cameroonian situation, these infrastructure developments are being offered by mining companies. In the

case of Gabon, the Chinese company CMEC has offered to build roads, railroads, a hydroelectric dam, and a deepwater port as part of a package that includes the mining rights for an iron-ore site near Belinga<sup>38</sup>. Belinga is located in the middle of an important conservation priority area. Although not in the middle of one of the new national parks, it is close to Minkebe National Park and other freshwater and forest resources (please see maps for an illustration of location within priority areas). The proposed infrastructure developments could very likely extend impacts into important conservation areas surrounding the mining site. The hydroelectric dam will likely be built on the Ivindo River<sup>39</sup>.

The developments at Belinga are located in a similar region as the prospective iron-ore mining site at Mbalam, Cameroon. Reports indicate that the two projects might somehow link railway projects. This seems unlikely, however, because the Belinga mine is more likely to link up with the existing TransGabonais railway, and the separate infrastructure development would be more likely to suit Gabon's interests to develop internal infrastructure networks<sup>40</sup>. The exact locations and pathways of infrastructure development associated with these two mines are unspecified to date. However, the incursion into high-priority forest and river areas at two separate projects could have significant cumulative impacts on the area. The resulting access from the various projects will increase habitat loss and diminish the intact areas. This area is part of an informal transboundary biodiversity conservation zone among the RoC, Cameroon, and Gabon.

The commitment Chinese companies have shown in developing mineral resources in Africa is exemplified by the broader commitment of the Chinese government to secure its relationships and partnerships with Gabon. For example, before the agreement was reached on the mining site near Belinga, Chinese President Hu Jintao visited Gabonese President Bongo Odimba, which reportedly coincided with the agreements for mineral and petroleum exploration rights<sup>41</sup>. The agreement included exploration rights by Sinopec, a Chinese oil company. Sinopec was reportedly engaged in exploration practices in Loanga National Park, which was in violation of its contract with the government.

Sinopec's exploration methods included more disruptive practices, such as the use of a system of seismic arrays and explosions that are set off in straight lines, which requires significant areas to be cleared for access. Such exploration practices can and have been intrusive and destructive, especially if located in areas of rich biodiversity. Newer exploration methods that can be less intrusive and damaging, such as "3-D and 4-D seismic imaging," provide better pictures of underground

reservoirs and their potential uses. The use of helicopters at testing sites can reduce the area that is cleared for transects. Helicopters have been used in Gabon, and elsewhere, resulting in less deforestation and reduced wildlife disturbance<sup>42</sup>.

Viewed as one of the “gems” of the newly established national park system, Loanga National Park is part of an initiative to develop ecotourism as an alternative income source. Sinopec’s exploration practices clearly violate established laws regarding national parks. The company’s practices severely disturb wildlife and habitats that are supposed to be protected under current legislation. Even more disconcerting is the lack of response on the part of the Gabonese government to halt or hinder such practices despite acknowledgment of the situation. Lack of enforcement regarding legislation that is supposed to pave the way for protected areas and further ecotourism activities is discouraging to possible investors, destructive to surrounding habitat, and harmful to the prospects of establishing economically viable eco-friendly income-generating activities. It is further indicative of the pressures to exploit mineral resources overriding conservation goals<sup>43</sup>.

Although the government of Gabon has taken encouraging steps in the direction of conserving its natural resources, such as establishing one of the world’s largest allocations of lands for national parks, there are some signs that pressure for minerals or oil could trump these conservation efforts. In 2002, the president of Gabon agreed to conserve 10 percent of the country’s territory through the establishment of national parks as part of the “Yaonde Process.” Each park in Gabon will be no less than 1,000 hectares. This is a tremendous effort on the part of the African nation to mix conservation efforts with the potential for revenue from ecotourism.

Relatively little money is given to natural resource management or monitoring in Gabon. A large amount of monitoring and maintenance for conservation initiatives comes from the international community. A regional EU-financed Programme for Conservation and Rational Utilization of Forest Ecosystems in Central Africa (ECOFAC) project assisting Gabon’s wildlife management had a budget of US\$520,000—a yearly budget nearly twice the size of the entire Wildlife Department’s operating budget of US\$280,000 in the mid- to late 1990s. More than half of the 310 agents employed by the Ministry of Water and Forests are based in Libreville, the capital. Additionally, two-thirds of the ministry’s vehicles are used in the capital and, in 1997, only 18 cars used by the ministry were used outside of Estuary Province<sup>44</sup>. These data may be several years old, and exact data are not available for current-year employees or vehicles. However, anecdotal accounts suggest that much has not changed. Representatives from the U.S. Department of the Interior’s National Park Service were part of the official

procedures establishing Gabon’s historic national park system in 2002, and they described the lack of radios, uniforms, vehicles, or ammunition for park guides and guards in the Loanga National Park<sup>45</sup>.

On a broader level, Gabon’s relatively low population and high revenues from oil have led to a highly concentrated urban population and decreased competitiveness of labor-intensive nonoil exports. Oil rents have contributed to rural-urban migration and concentrations of population, especially in cities, and to the flight of communities from rural areas because of decreased opportunities to meet livelihood needs. Neglect by the Gabonese government to rural area development and other nonoil sectors, such as agriculture, has reinforced the need for people to concentrate in urban centers. This has amounted to a neglected rural economy and infrastructure, and limited deforestation, not so much by design as by lack of attention and lack of economic competitiveness. Diminishing oil reserves in coming years may force a shift in government attention back to rural development.

Alternatives to oil incomes, other minerals, logging, and agriculture may be pursued in light of declining oil wealth. Logging in Gabon has been primarily selective, with relatively low deforestation impacts. The *okoumé* tree is the primary exported variety of soft wood from Gabon, and it is transported through the country via its network of rivers and by railroad. This is apparent throughout the country because huge logs can be found washed up on the shore, where they have “escaped” from handlers<sup>46</sup>. The large railway network of the TransGabonais Railway was established partially as a means to transport logs and timber from the southeast to the western coast for export. Income from timber accounts for 50 percent of railway revenues<sup>47</sup>. Such practices in Gabon have limited deforestation, although not necessarily through mandate but rather by default, and could change with shifting sectoral focus in the future.

### Key Players

*Government:* The Ministry of Mines, Energy, and Petroleum has exclusive rights to grant prospecting, exploration, and mining permits. All useful minerals under the surface are the property of the state. The state maintains a partial stake in most of the mining sites in partnership with French, Canadian, Danish, and Chinese companies through smaller state-controlled companies.

*Private Sector:* One of the biggest operators is the French company Eramet, which operates through various subsidiaries, such as Comilog. The French companies Eramet and Areva are involved with several mining activities, including the rights to iron, uranium, and manganese in the Okouma, Bangombe (Fines), Mékambo, and Moanda mines. French interests are further involved in Gabon: the Atomic Energy



Commission also has interests in Eramet. The Dutch Niobium Resources BV owns a large portion of a Niobium deposit at Mabounié, and the Canadian Searchgold Resources Inc. owns a dominant share of a gold project at Bakoudou. The Chinese have made new inroads into the country through the engagement of the CMEC at the Belinga iron-ore mining site and Sinopec's engagement in the country within Loanga. The Australian company Lafayette holds rights to a gold-mining effort at Eteke, and mining giant CVRD is conducting surveys for manganese in the Okondja and Franceville regions<sup>48</sup>.

**3.3 The Democratic Republic of Congo:** The DRC is the third-largest country in Africa and contains some of the largest tracts of intact forests in the region; more than 70 percent of the country is forested<sup>49</sup>. The DRC holds tremendous mineral deposits actively being explored as well as underground deposits. In addition to oil and timber, it contains some of Africa's largest deposits of copper, cobalt, and coltan and has significant reserves of gold, diamonds, cadmium, zinc, cassiterite, magnesium coal, and other minerals. Unfortunately, the relationship between minerals (more specifically the wealth derived from minerals) and governing powers has resulted in a legacy of exploitation and violence that dates to the days of Belgian colonial control. Because of civil war and an unstable government, exploitation of minerals has declined dramatically in the last five years. Before the civil war, minerals accounted for up to 25 percent of GDP, but the mining sector accounted for only about 7 percent of GDP in 2001 and 9 percent in 2004. Political instability has meant that the informal economic sectors fared better than the formal sectors. In 2004, the IMF estimated that informal diamond production reached 22.1 million carats compared with only 8.8 million carats in the formal sector<sup>50</sup>.

Much of the mining activity is located in the southeast and eastern parts of the country, notably in Katanga and Kivu (Nord and Sud) Provinces. Most of the mining activities occur outside of the forest and river systems that are targeted as conservation priorities by WWF. In fact, it may be the density of the forest areas and river systems that have limited access to these reserves. Following elections and the end of civil war, stabilization in the country could encourage the development of the mining and logging sectors, resulting in an incursion into the more densely vegetated parts of the country<sup>51</sup>.

The scourges of corruption and informal governance have left the extractive industries vulnerable to local armed militia control, including incursions from groups based in countries bordering the DRC (such as Uganda, Rwanda, and Burundi). The deterioration in control and management of natural resources has resulted in charges of human rights abuses, kidnapping, forced labor in mines, rape, torture, and ethnic slaughter. These practices have included complicity of some

mining companies through their ties to local militias<sup>52</sup>. Gold concessions that are inactive tend to be taken over by armed groups that victimize artisanal miners and lead to arms trafficking and embargo violations<sup>53</sup>.

Officials in the DRC, in collaboration with the World Bank Group, have developed a set of Mining and Forestry Codes to harness and develop two lucrative sectors that could help drive and rehabilitate the ravaged economy of the DRC. The mining codes were implemented in 2003 and have restored some interest in the mining sector. In the case of diamonds, the mining code gives the Prospecting Research Permit holder exclusive rights for four years. If an economically viable resource is found<sup>54</sup>, the permit holder has the potential to extend and then apply for a Permit of Exploration. These codes are meant to add a degree of transparency and reform to the sector. Further rehabilitation of the mining sector has included the delineation of mining concessions and exploration rights. The DRC's mining cadastre now lists 2,144 mining and quarrying concessions, but the country lacks strong governance and monitoring capabilities. Development strategies in the natural resource sectors include a projected 60 percent increase in logging, which has raised concerns about the potentially devastating environmental and social impacts of overexploitation of natural resources<sup>55</sup>.

Insofar as economic involvement in the DRC continues post-conflict, the international community has expressed an interest in enhancing the administration of mineral deposits, promoting certification requirements, and ensuring compliance with governance policies, including transactions with neighboring countries. Radioactive materials, such as uranium, radium, and cesium, have been discovered in neighboring countries after being smuggled out of the DRC. Despite assurances from the Ministry of Mines, artisanal miners use and are charged fees for the use of closed mines, which violates domestic policy and international agreement. As a result of frequent infractions, the integrity of the natural resource industry is impaired to the detriment of the country's workforce, government, and overall economy<sup>56</sup>. The UN Security Council (UNSC) has maintained a constant presence in the DRC and has encouraged further investigations by a panel of experts to research the situation in the DRC. This involvement comes as a result of UN Security Council Resolutions concerning the civil conflict. Of main concern are the use of child soldiers, continued presence of armed militias, arms trafficking, and illicit mineral trafficking.

Mining activities, in combination with internally displaced populations and external refugees, are deleteriously affecting many of the DRC's important natural resources. One such example is the Kahuzi-Biega National Park—a World Heritage site—where coltan mining and refugees have decimated elephant, gorilla, and other species populations, as

well as continuing destructive clearing and wood harvesting. In compliance with the Kimberley Process, of which the DRC is a member, a certification system was established to ensure that diamonds are not conflict diamonds (or “blood” diamonds). The Kimberley Process seeks to limit the sale and export of conflict diamonds by monitoring mining operations and providing certificates of origin.

The mining sector and government agencies continue to suffer from many years of ineffective governance and instability. Joint-venture companies continue to hold inactive concessions, decreasing the government’s ability to explore or exploit some deposits<sup>57</sup>. This limits the country’s potential future revenues, in spite of government efforts toward implementing more transparent practices. The parastatal group Okimo is characterized by weak management, inefficiency, and corruption, which hampers its ability to maximize profits and increases its susceptibility to manipulation by armed militias. UNSC investigations found that parallel government agencies were set up to control the mining sector, including artisanal miners, that allowed for collaboration with armed groups, who extracted taxes as well as royalties from artisanal miners. Companies also pay export taxes to rebel groups controlling the country’s borders, effectively shutting down once-profitable companies as they become laden with high charges and frequent interruptions<sup>58</sup>.

Lack of government control over mining sites has meant that mines are closed or that production is slowed, evolving into an inhospitable operating environment for many companies. Local militia groups charge excessive fees to allow companies to transport mined products. These revenues rarely reach government coffers. For example, the Lueshe mine, producing pyrochlor, has had its production and equipment appropriated for armed militia personal use. This interference has resulted in interrupted production, hindering potential benefits to the DRC and affecting jobs for local employees. Local companies routinely work in collusion with the local governing bodies to control armed militias and pass significant quantities of radioactive materials out of the country<sup>59</sup>.

### Key Players

*Government:* The Ministry of Mines controls the mining sector, under which Gécamines controls most of the state-owned mining activities. Following the recent turmoil, much of the country’s mining sector is in disarray. Mining activities have fallen into the hands of armed militia groups or otherwise have been abandoned as a result of the unfavorable operating conditions. The Katanga Province in the southeastern corner of the country is part of the copper belt. The state-owned Gécamines has struggled to increase capacity and production levels. The South African company Metorex has reached an agreement to treat the high-grade copper and cobalt in Katanga Province.

*Private Sector:* Few companies have succeeded in developing deposits as a result of the conflicts. Anvil Mining, however, does operate a copper and silver mine in Dikulushi and is expected to continue to increase production. Most of the gold mines are controlled by armed militias; only Banro and an Anglo-American/Barrick joint venture have had much success in setting up gold-mining operations. The DRC’s only zinc-copper mine has considerable potential; however, it is inoperable because of lack of funding. America Mineral Fields (AMF) and South African Zincor are planning to engage in studies to reopen this mine. Oil plays a significant role in the DRC’s economy, mainly from six onshore oil fields operated by Perenco, which also operates the DRC’s offshore concession and terminal(SADC)<sup>60</sup>.

Gécamines, the DRC's quasi-governmental mining operation, runs numerous mines and subsidiary companies and has formed joint-venture partnerships with several companies, including the following:

- Adastra (Canadian)—connected to AMF—and possibly First Quantum has joint-venture holdings with Gécamines at Kipushi Zinc and Kolwezi copper/cobalt/tailings. These projects are still being developed but look to be feasible; Kolwezi is more advanced than the Kipushi project. Anglo-American also has a stake in the Kolwezi copper field.
- Phelps Dodge (United States) has a joint venture with Tenke Mining Corporation (Canadian) and Gécamines at Tenke Fungurume for copper and cobalt that could come on line this year or next.
- International Panorama Resource Corporation (Canadian) has entered into a joint venture with Gécamines to operate the copper mines at Kakanda/Kambove.
- Iscor (South African connected with Mittal Steel) has entered into a joint venture with Gécamines to operate the copper mine at Kamoto.
- SODIMZA operates a copper mine at Musoshi.
- Moto Goldmines, with partial ownership of GoldenStar (United States) is operating a gold mine in Kilo-Moto.
- First Quantum (Canadian) is operating and exploring copper and cobalt in Katanga Province although further details are not available.
- Anvil Mining (Australian) is operating copper and cobalt mines at Dikulushi, Mutoshi, and Kinsevere. Some employees are facing charges of complicity with armed militias.
- Banro (Canadian)/Anglo-American/Barrick joint ventures have had much success in setting up gold mines in the Kivu region, although their practices have come into question.
- Metorex (South African) has also reached an agreement to treat copper in Katanga province.
- AngloGold Ashanti is exploring gold in the Kilo-Moto region, although some people from the company are facing charges of participation with a local armed militia<sup>61</sup>.

**Illegal Mining Practices:** The DRC's mining cadastre includes individuals or firms of questionable character and standing. Central African Mining and Exploration Company, Boss Mining, and Ruashi Mining have all been identified as companies with shareholders of questionable integrity. State-controlled mines (Gécamines, Miba, Okimo) have been recommended to provide a list of their joint-venture partnerships. Natural resource exports from the DRC are not guaranteed in terms of the origin, legality, or possibility of funding armed militias.

Sketchy characters continue to linger in the region's mining sector. Billy Rautenbach left South Africa after a warrant was issued for his arrest. From 1998 to 2000, Rautenbach was the head of Gécamines, the Congolese state-owned mining company. He was removed because of diversions of copper and cobalt from the state company to his personal company. Rautenbach has since acquired holdings in other mining ventures in the DRC through his holding companies, thereby continuing his legacy of unethical practices by underreporting shipping qualities and quantities of ore. This practice shortchanges the government of the DRC by thousands (possibly millions) of dollars<sup>62</sup>. The UNSC has compiled a list of actors in the DRC's mining sector who have questionable characters. An investigation is pending into AngloGold Ashanti's participation with a local armed militia group, Front Nationaliste Integrationiste (FNI), in the area of Mongbwalu. In addition, a Congolese judge recommended the prosecution of three former AngloGold Ashanti employees for their participation in war crimes<sup>63</sup>.

**3.4 Republic of Congo:** Once one of Africa's dominant oil exporters, the RoC has suffered from instability and civil war. Although there was an official halt to fighting in 1997, conflicts have flared periodically, adding to the tenuous situation and an influx of refugees, which has made governance difficult. Even with reduced production, petroleum continues to outpace forestry as the mainstay of the economy, and increasing oil prices have given a slight boost to government revenues. The RoC has been troubled by debt and issues of fiscal management and continues to consult with the IMF in regard to restructuring initiatives.

**3.5 Equatorial Guinea:** Discovery and exploitation of petroleum reserves off the coast of Equatorial Guinea have provided a windfall of money to the government, leading to a significantly increased GDP and ranking the tiny nation as the fastest-growing economy in Africa. Currently, 97 percent of export earnings are derived from petroleum<sup>64</sup>. President Mbasogo maintains autocratic control of the government since he seized power in a coup in 1979. Second to petroleum, timber retains its status as one of the country's primary exports, yet there is seemingly little incentive to invest in sustainable harvesting because the sector now includes only about 2

percent of export earnings. Equatorial Guinea has a long history of cocoa production; however, years of rural and agricultural neglect have left the country with little income outside of petroleum revenues. The IMF has disengaged from the country because of corruption and poor management of resources that hinder project implementation. Equatorial Guinea allows little monitoring or intervention from outside groups. Because the current inflow of petro-dollars is predicted to buoy the country for some time, the Mbasogo administration has demonstrated little initiative to significantly engage with the international community.

**3.6 Central African Republic:** CAR is one of the poorest countries in the world, with more than 67 percent of its population living below the poverty line. The country is characterized by tremendous instability, with no less than four coups in just over a decade and continued violence and insecurity<sup>65</sup>. Agriculture and forestry are among the main export earners outside of diamonds, and the country remains largely self-sufficient in terms of food production. The mining sector in CAR is generally limited to artisanal mining, with 98 percent of diamonds and 100 percent of gold being produced in this fashion. Mining companies allow miners to exploit large portions of their land and then sell their production to collecting agencies<sup>66</sup>. Mining practices are labor intensive, thus allowing for participation of many rural residents, estimated at up to 70 percent of the country's population<sup>67</sup>.

CAR does not have a formally developed mining industry, partially because of the lack of infrastructure and an inhospitable investment environment. Much of the country's terrain has yet to be fully explored and holds potential for future development, including iron and gold deposits. Of significance is the gold and iron deposit at Topa in the southeastern portion of the country. CAR is engaged in a multilateral conservation area with Cameroon and the RoC (the Tri-Sangha Region) near this location. The Topa deposit falls within proximity to the priority area and could pose potential conflicts with conservation priorities, especially if pressure increases to develop this area. With minimal infrastructure already in place, the impacts and disturbances to surrounding areas would likely be significant, although halting any development in the country may be difficult given the lack of other economic opportunities and extreme poverty. Like Cameroon, CAR is reviewing its mining sector regulations, which will be aimed at attracting and encouraging investment in the mining sector. Mineral or other infrastructure development in this area potentially could threaten the ability to conserve the wildlife habitat across borders.



**4. Conclusions.** Striking a balance between conserving natural resources and development needs is the main challenge for the CBR. The region is endowed with an abundance of natural resources, and the high revenues that can be derived from their exploitation are significant. Ensuring that the development of such resources alleviates poverty while maintaining the natural resource wealth for future generations is the key challenge for the region's policy makers. This assessment has reviewed the potential environmental and social impacts that infrastructure and natural resource development may have on WWF's ecoregion priorities in the Congo Basin. The analysis led to the following findings:

- *Infrastructure associated with mining and logging poses a substantial threat to forests.* Infrastructure development is an integral part of mining and logging. Although new methods are evolving that cause less impact to surrounding areas, mining exploration and extraction require and use access roads, settlements for workers, mines, and processing facilities as part of daily operations. Furthermore, infrastructure is needed to transport minerals, or logs, as well as other operational structures such as power plants. Expanding these sectors will require major investments in the region's infrastructure, which (if developed without proper safeguards) will negatively affect WWF's priority ecoregions. In addition, natural resource extraction can lead to increased access to previously remote forested areas for bushmeat hunters.

- *High mineral prices are encouraging the development of mineral deposits, including the development of previously unviable deposits.* World mineral prices are at record highs, fueled in large part by increasing demand from China and India. The high price of minerals has made previously unviable mineral deposits more attractive for developers. Lucrative returns from minerals provide ample reason for companies to invest significant amounts of money into developing mining sites. Companies are investing in railways, ports, dams, and roads—in some cases even offering to build infrastructure that is unrelated to the natural resource concession. This new trend acts as an incentive for governments that have limited resources for infrastructure development. The development and “cozy” relations between companies and governments can make monitoring the performance of corporate players more difficult.

- *Governments that rely on oil wealth may be facing shortages that encourage nonoil mineral development or pressures to increase logging or agricultural output.* Several of the CBR countries are facing declining oil outputs. Although oil prices remain high, the decline in available petroleum reserves has resulted in a decrease in revenue for the government. In light of potential diminished earnings, countries may shift their focus to developing other mineral deposits or may encourage

the development of agriculture. Growth of nonoil sectors may be related directly to detrimental environmental practices: agricultural expansion cuts directly into forested areas and mineral deposits and their associated infrastructure overlaps with rich, biodiverse areas. Government policies directed toward expanding these high-value sectors will likely take precedence over conservation priorities.

- *Mineral extraction has contributed to violent conflict, and most of the countries in the region lack the political will or resources to ensure compliance with national and international norms and regulations. Instability has plagued many countries in the region.* Control of natural resources has funded armed activity, fueling civil conflict. Although the extraction of high-value natural resources could provide much-needed revenue for government coffers, such development will contribute to poverty alleviation only if the benefits are equitably distributed and a strong monitoring and enforcement system is in place to ensure that companies operate in an environmentally responsible manner. At the moment, most of the countries lack the basic infrastructure to adequately enforce the law, let alone the political will to institute good governance measures.

- *Some countries have taken positive steps toward conserving the rich biodiversity in the region, but such measures may not be sufficient in light of economic development interests.* Several countries in the Congo Basin have demonstrated an interest in conserving their natural heritage by delineating new national parks, signing international agreements to monitor resource extraction, and protecting habitat vital to wildlife species. However, economic needs could trump conservation priorities. Such activities as pursuing the development of high-value natural resources in a national park, failing to enforce national policies surrounding natural resource use, or creating policies directly targeted toward economic expansion into high-priority conservation areas indicate that economic development may take priority over conservation commitments.

**5. Recommendations.** The natural wealth of the Congo Basin countries could provide a legitimate basis for alleviating the crippling poverty of the region. For this to occur, however, important measures must be in place to ensure that (1) revenues derived from natural resource extraction are equitably distributed and (2) the natural resource base is conserved for use by future generations.

- *Strengthen governance in the region, especially transparency of natural resource concession arrangements and revenue distribution.* There is little hope for natural resource extraction to contribute meaningfully to poverty alleviation under the current system of corruption and political cronyism that is in place in most CBR countries. Countries with extractive resources should sign the Extractive Industries Transparency Initiative (EITI) and should publicly disclose specific contractual arrangement with companies, revenues received by the project, and the distribution of natural resource rents.

- *Strengthen and invest in better field monitoring, border controls, and resource transport systems.* The lack of adequate monitoring and enforcement has led to rampant illegal activity in several countries in the region (especially the DRC). Priority should be placed on strengthening border controls, requiring certificates of origin, and implementing transportation norms in remote sites where resource extraction occurs.

- *Require companies to operate by international standards for resource extraction.* All companies should be required to provide Environmental Impact Assessments (EIAs) at the exploration stage of a concession. Although international standards for mining are not yet available, a global process for defining such standards is under way. Two WWF documents outlining criteria and standards for “responsible” mining will form the basis for the development of these international standards—the results of the WWF Australia Mining Certification Evaluation Project (MCEP) and the Framework for Responsible Mining. Both documents can be used to negotiate specific practices proposed by mining companies seeking to develop concessions in the region.

- *Choose infrastructure routes that avoid or reduce habitat access and fragmentation and ensure that infrastructure development follows best practice.* Strategically planning railroads, roads, and other physical infrastructure can result in less habitat disruption if these access routes do not open up otherwise remote regions and if they are coordinated to serve several development needs. In addition, all infrastructure development should be planned in the context of evaluating alternatives (including the “no-go” option) for providing the same service, and ensuring that transport and energy infrastructure is built according to best international practice.

- *Ensure that local populations are involved in resource extraction decisions.* Development that benefits the majority of the region’s inhabitants will require the participation of local populations in development decisions. Companies should be required to consult with and obtain the consent of communities living in the vicinity of their concessions. In addition, natural resource development options that strengthen smallholder production (such as artisanal mining) typically employ larger numbers of local populations and can be beneficial if practiced in a manner that is environmentally and socially responsible. Mining companies should be encouraged and rewarded for entering into partnerships with artisanal miners that allow local communities to benefit from mineral extraction while training miners to employ environmentally friendly extraction technologies.

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