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**Breaking Ships in the World-System: An Analysis of Two Ship Breaking
Capitals, Alang, India and Chittagong, Bangladesh**

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Abstract

Centrality in the world-system allows countries to externalize their hazards or environmental harms on others. Core countries, for instance, dump heavy metals and greenhouse gases into the global sinks, and some of the core's hazardous products, production processes and wastes are displaced to the peripheral zones of the world-system. Since few peripheral countries have the ability to assess and manage the risks associated with such hazards, the transfer of core hazards to the periphery has adverse environmental and socio-economic consequences for many of these countries. Such export practices are therefore contributing to the globalization of health, safety, and environmental risks. Most discussions of the risk globalization problem have failed to situate the problem firmly in a world-system frame. This paper begins such a discussion by examining the specific problem of ship breaking in Alang, India and Chittagong, Bangladesh.

Keywords: Ship Breaking; Hazardous Wastes; Environmental Injustice; Risk Globalization; World-Systems Theory; Ecological Unequal Exchange; Political Ecology; Capital Accumulation; Recycling

INTRODUCTION

The world-system is a global economic system in which goods and services are produced for profit and the process of capital accumulation must be continuous if the system is to survive. (1) The world-system can be conceptualized as a three-tiered open system (consisting of a core, semi-periphery, and periphery) that can be understood not only in “economic” terms but in “physical or metabolic” terms: entry of energy and materials and exit of dissipated energy and material waste (Frey 1998a; Hornborg 2011; Martinez-Alier 2007, 2009; Rice 2007, 2009). In fact, the world-system and globalization itself can be described in terms of a process of “ecological unequal exchange” (e.g., Hornborg 2011; Rice 2007, 2009) or a process of “accumulation by extraction and contamination” (Martinez-Alier, 2009). Frey (2006a, 2013a) has described the process of ecological unequal exchange in terms of wealth and anti-wealth flows between core and periphery.

Wealth (in the form of economic value, as well as material and energy) flows from the resource-rich countries of the periphery or “resource frontiers” to the industrialized countries of the core with adverse environmental and socio-economic consequences for the periphery (see, e.g., Bunker, 1985, 2007; Bunker and Ciccantell, 2005; Clark and Foster, 2009; Hornborg, 2011; Moore, 2007, 2010a, 2010b; Robins, 2011). (2) On the other hand, the core displaces anti-wealth (wastes, entropy broadly defined or appropriates carrying capacity) by transporting it to the global sinks and to sinks or “waste frontiers” located in the peripheral zones of the world-system. Heavy metals, carbon dioxide and other greenhouse gases, as well as other hazardous materials such as lead are pumped into the global atmosphere at high rates by the affluent or core countries of the world-system (see, e.g., Dietz and Rosa, 1997; Jorgenson, 2006; Kentor and Grimes, 2006; Roberts, Grimes, and Manale, 2006; Prew, 2010; Roberts and Parks, 2007; York, Rosa, and

Dietz, 2003; York and Rosa, 2006). In turn, transnational corporations (TNCs) located in core countries export hazards to the peripheral zones of the world-system, including hazardous products (e.g., cigarettes, pesticides, and asbestos), production processes (dirty industries such as benzene and pesticide production plants), and wastes (e-waste, lead batteries, and other wastes such as phenols, mercaptans, hydrogen sulfide) (see, e.g., Auyero and Swistun, 2009; Clapp, 2001; Dick and Jorgenson, 2011; Frey, 1995, 1998a, 1998b, 2006a, 2006b, 2012a, 2012b; Grineski et al., 2010; Hooks and Smith, 2011; Margai and Barry, 2011; Pellow, 2007:73-224; Rice, 2011). (3) These export practices not only damage the environment, but they have adverse health, safety, and socio-economic consequences for the human populations of the periphery and they represent a form of environmental injustice (e.g., Bullard et al., 2005; Margai and Barry, 2011). Peripheral countries are particularly vulnerable to the risks posed by hazardous exports because peripheral states and domestic firms have limited means for or interest in assessing and managing risks and many workers and citizens are often unaware of the risks associated with these hazards.

This paper examines in detail one core-based hazardous export to the periphery: the transfer of the core's ocean-going ships to Alang, India and Chittagong, Bangladesh for breaking. (4) These two geographic sites (some would say "toxic hotspots" or "sacrifice zones") are the ship breaking capitals of the world since a majority of the world's ships are broken on their beaches. Ship breaking is the process of dismantling and recycling or scrapping a ship for steel and other materials when it is no longer profitable for transport use due to age, as well as low shipping rates and/or high steel prices. The case of ship breaking documents one of the ways in which asymmetric, core-periphery relations are reproduced in the world-system. In other words, the process of "ecological unequal exchange" (as defined in terms of wealth and anti-wealth flows

as noted above) facilitates core capital accumulation within the current world-system through extraction from and contamination of the periphery. (5)

Discussion of this particular form of core-periphery reproduction or core capital accumulation proceeds in five steps. The nature and scope of ship breaking are first examined and the specific political-economic forces driving the transfer of ships to the periphery for breaking are outlined. The extent to which ship breaking contributes to adverse health, safety, environmental, and socio-economic consequences in the periphery is then examined. An approximate analysis of the costs and benefits is presented in an effort to assess the neo-liberal claim that the movement of ship breaking and other hazards to the periphery is beneficial to the core and the states, domestic firms, workers, and citizens of these two peripheral countries. Various policy and political responses to curb the adverse consequences of ship breaking are briefly reviewed and discussed. It is argued that conventional efforts (whether “globalization of regulation” or “renationalization of capital”) to deal with ship breaking and other hazardous exports are unrealistic because they fail to take into account the existence of a world-system based on “ecologically unequal relationships” between core and periphery. The paper concludes with several suggestions for future research on the hazardous waste stream in the world-system.

THE NATURE AND SCOPE OF SHIP BREAKING IN BANGLADESH AND INDIA

The global shipping industry (which facilitates the transport of wealth to the core and anti-wealth to the periphery) is one of the major components of the infrastructure underlying the world-system’s social metabolism. (6) Consider, for instance, the fact that a majority of the global trade in materials and goods is by sea (80% of all raw materials and manufactured goods). Slightly more than 100,000 ocean-going vessels were operating during the 2009-2010 period (see Demaria, 2010; International Maritime Industry, 2011:8; World Bank, 2010).

After an average life span of 25 to 30 years or longer, many ocean-going vessels are scrapped for their steel and other resources, though the number of vessels sent to the breaking yards varies according to freight charges and steel prices (Demaria, 2010; Greenpeace International, 2000, 2001; World Bank, 2010). The industry is subject to boom and bust cycles. It thrives during times of economic contraction and declines during periods of economic growth. Approximately 1,000 (more than 25 million tons) of the 100,000 ocean-going vessels (oil tankers, container ships, bulk carriers, naval ships, chemical tankers, and general cargo ships) were sent to the periphery in 2009 for scrapping (Puthucherril, 2010:12-14; Robindebois.org, 2010; World Bank, 2010:3; see also Greenpeace International, 2000 for earlier figures). The number of ships broken increased dramatically during the economic downturn in 2008-2009 when there was excess shipping capacity (Robindebois.org, 2009). (See Figure 1 for the annual gross tons broken between 1999 and 2009.) And it is expected that there will be a dramatic increase in the number of ships broken in the near future as a result of the International Maritime Organization's regulation phasing out older, single-hull tankers during the period from 2010 to 2015 (Karim, 2010; Puthucherril, 2010:14; World Bank, 2010). Other options for obsolete ships or ships of limited economic value include moth-balling or scuttling, but these options are problematic: moth-balling does not solve the long-term problem of disposal and sinking a ship leads to toxic discharges and forgoes the recyclable value of the ship (Puthucherril, 2010:14)

(Figure 1 about here)

Over 90 percent of the vessels slated for breaking (typically owned by interests based in the core but sailing under foreign flags) are currently transported to Bangladesh, Pakistan, China, the Philippines, Turkey, and Vietnam. (The remaining ships are broken in locations such as the United Kingdom under strict health, safety, and environmental regulation.) Ship breaking is

pursued in these countries because labor is cheap; health, safety, and environmental regulations are weak; and workers are desperate for jobs. The ship breaking industry was centered in the United States, Japan, and the United Kingdom during and after World War II, but it moved to Turkey and Spain in the 1960s, then to Korea and Taiwan in the 1970s, and it shifted to several countries in South and Southeast Asia starting in the mid-1980s (Demaria, 2010; World Bank, 2010). In other words, ship breaking moved from the core to several peripheral countries in Asia when the cost of breaking ships in the core (due to increased regulations and other forms of “*ecological modernization*,” as well as increased labor costs estimated to be more than 50 times that of developing countries [Rousmaniere and Raj, 2007:362]) exceeded the price obtained from the scrapped metal. (7)

Ship breaking is clearly a “pollution haven” industry since it has moved from several core countries to Bangladesh, India, Pakistan, and several other peripheral countries due to increased environmental, health, and safety regulations in the core. (8) But other factors have contributed to the movement of the ship breaking industry to South and Southeast Asia (see, e.g., Buerk, 2006; Demaria, 2010; Hossain and Islam, 2006:2). These include strong domestic markets for steel and other materials; the temperate climate of the region allows ship breaking to take place throughout the year; high tides and favorable beach conditions; and close proximity to the main eastbound sea trade routes.

Sixty to seventy percent of the ships scrapped each year go to Alang, India (often described as the current ship breaking capital of the world-system) and Chittagong, Bangladesh (Greenpeace International and International Federation for Human Rights, 2005; Robindebois.org, 2009, 2010, 2011; World Bank, 2010:14), though China has become increasingly important in breaking ships and will likely become more important in the future. (See Figure 2 for the geographic

location of the two ship breaking capitals in Bangladesh and India.) Leadership in ship breaking has alternated between India and Bangladesh over the last ten years (World Bank, 2010:14).

(Figure 2 about here)

Steps in Breaking a Ship

Brokers based in Dubai, Hamburg, London (where Clarkson, the world's largest ship broker is based), and Singapore sell the core's ships (typically registered under flags of convenience) to breakers who pay anywhere from 400 to 500 dollars or more per ton for the ships (Robindebois.org, 2010). The buyers have a financial incentive to break ships quickly so they can recover their investments. It normally takes a workforce of 200 to 250 workers three to five months to dismantle an average-sized ship (Demaria, 2010).

Several steps are followed in this extremely dangerous process once the ship is anchored offshore (see, e.g., Buerk, 2006; Demaria, 2010; Langewiesche, 2004; Puthucherril, 2011:285-286; Rousmaniere and Raj, 2007; World Bank, 2010). Local authorities must first complete various legal formalities (ensuring, for example, the ship is gas free to reduce the risk of explosions). The ship is then beached at full speed during high tide. Once the ship is beached, workers vent flammable gases in the interior of the ship by hammering or punching large holes in the hull and seawater during high tide washes out the fuel tanks. Ships are stripped of all furnishings and appliances, as well as other material (such as asbestos, generators, wiring, life boats, life vests, pipes, toilets, wash basins, navigation equipment, wooden doors, foam, and the like) and often sold along the road outside the yards. Large sections of the ship are then cut off by gas torches and dragged closer to shore by giant winches. The large sections of steel are cut into smaller pieces and teams of men carry the metal sections to trucks for loading and removal.

The steel is shipped to re-rolling mills for recycling. The recycled steel (often in the form of reinforcement rods) is used nationally in building and road construction.

Thousands of migrant workers (mostly young, male, and illiterate) from poor rural areas are employed in the ship breaking yards. Workers are categorized into several groups: those using torches to cut up ships and their helpers, those carrying large iron plates, laborers, contractors, supervisors, winch operators, crane drivers, fitters, carpenters, asbestos workers, and firemen. Daily wages are anywhere from \$2 to \$7 per day, depending on the job (DeMaria, 2010; Puthucherril, 2011:287).

The Case of Alang, India

Alang is located in the highly prosperous, manufacturing state of Gujarat and the shipyards are located on a six-mile stretch of beach on the western coast of the Gulf of Cambay. Ship breaking employed over 40,000 workers and others in related industries in early 2000 and upwards of 50,000 by 2009 (Demaria, 2010; Greenpeace International, 2000, 2001; International Federation for Human Rights, 2002). (See Figure 3 for a photograph of plots in Alang.) Established in 1982, the Alang plots and (a site nearby in Sosiya) is the largest breaking yard in the world in terms of the actual number of ships broken. Alang was the number one ship breaking site in 2007 (with 129 ships), 2008 (194), 2009 (435), 2010 (422), and the first part of 2011 (see Robindesbois.org, 2008, 2009, 2010, 2011). An average of approximately 200 ships have been dismantled each year for the past decade (Robindebois.org, 2010). Over 5,000 ships have been dismantled since the yard opened (Demaria, 2010:255). In addition to the recycling of steel and other metals, hazardous wastes are generated as noted above (Basha et al, 2007; Demaria, 2010; Greenpeace International, 2001; Reddy et al., 2005).

(Figure 3 about here)

The Case of Chittagong, Bangladesh

Chittagong is the primary port of Bangladesh and the center of much of the country's industry (Rousmaniere and Raj, 2007; World Bank, 2010). The Chittagong yards are located on a ten-mile stretch of beach named Fauzdarhat, which is approximately twelve miles northwest of Chittagong and located on the Bay of Bengal. Ship breaking was introduced in 1969 when a vessel (the Greek ship M.D. Alpine) was beached on the shore during a storm (Puthucherril, 2010:27). Large ships (tankers, cargo ships, and container ships) have traditionally been dismantled at the yards. The yards have employed upwards of 20,000 to 22,000 workers and 200,000 people are thought to be employed in businesses related to ship breaking such as shops and re-rolling mills, and the dependents of workers may number as many as 500,000 people (Buerk, 2006; Hossain and Islam, 2006; Puthcherril, 2010:28; World Bank, 2010). The Bangladesh Ship Breakers Association and government officials (Anonymous, 2008; Basha et al., 2007) maintain that Chittagong surpassed Alang in terms of steel tons broken in late 2008 but the Bangladeshi Supreme Court put heavy restrictions on importing ships for breaking in early 2010 that reduced the number of ships broken in 2010 and 2011 (Robindebois.org, 2010; 2011). The numbers of ships dismantled each year from 2007 to 2010 were 105, 182, 214, and 93, respectively (Robindebois.org, 2008, 2009, 2010, 2011). The future of ship breaking remains somewhat uncertain in Chittagong, though recent developments suggest that ship breaking will return to its previous level (Anonymous, 2011). Hazardous materials and unsafe dismantling practices, as noted above, are pervasive in the yards (Basha et al., 2007; Greenpeace International and International Federation for Human Rights, 2005; International Federation for Human Rights and Young Power in Social Action, 2008; Rousmaniere and Raj, 2007; World Bank, 2010).

ADVERSE CONSEQUENCES

Approximately 95 percent of an ocean-going vessel's bulk consists of steel (much of which can be recycled) and the remaining 5% consists of hazardous materials (Greenpeace International, 2000; World Bank, 2010). Hazardous materials include oil sludge, toxic paints, asbestos, halons in foam and firefighting equipment (ozone depleting substances), fuel residues, heavy metals (arsenic, cadmium, chromium, lead, mercury), organotins or biocides, persistent organic pollutants (dioxins, PVCs, PAHs), and radioactive substances (Basha et al., 2007; Buerk, 2006; Demaria, 2010; Greenpeace International and International Federation for Human Rights, 2005; Hossain and Islam, 2006; Puthucherril, 2010:18-19; Reddy et al., 2005). Such hazards can damage the environment and adversely affect human health through occupational exposure and environmental dispersion of hazardous wastes and substances in the soil, water, and air or large-scale failures such as explosions and fires. Workers come into direct contact with toxic materials on the job and in their squalid sleeping quarters located in the yards (Basha et al., 2007; Greenpeace International, 2001; Greenpeace International and International Federation for Human Rights, 2005; Hossain and Islam, 2000; Reddy et al., 2005; World Bank, 2010). Numerous undesirable social and economic consequences are also associated with ship breaking, including staggering economic costs and an inequitable distribution of costs and benefits (World Bank, 2010).

Bangladesh and India are particularly vulnerable to the risks posed by ship breaking because of the young, poorly trained, uninformed, undernourished, unhealthy, migrant workforce with limited access to safety and protective equipment and limited risk assessment and management skills (e.g., Demaria, 2010; Greenpeace International and International Federation for Human Rights, 2005; Hossain and Islam, 2006; International Federation for Human Rights, 2002). (9)

The heavy humidity and heat in the local environment discourages the use of protective clothing and gear even when it is available. Most of the work is done by hand with hammers, torches, and crowbars (Puthucherril, 2011:286)

Other problems exist, including limited awareness of the risks associated with hazards, nonexistent labor unions, politically unresponsive state agencies, inadequate risk assessment and management capabilities, and limited health care facilities. In addition, organized activism among workers is limited because potential participants are unaware of their rights and have little time for such activity since they work six days a week and there are few channels through the courts or legislature for effective public participation. (10) The problem is compounded by labor conditions: workdays are often from 7:00 a.m. to 7:00 p.m. with no overtime or leave benefits, and wages are anywhere from \$2.00 to \$7.00 (or less) per day depending on the specific job and location (Demaria, 2010; International Federation for Human Rights, 2002; Greenpeace International and International Federation for Human Rights, 2005; Hossain and Islam, 2006; World Bank, 2010).

Environmental Risks

Emissions of toxic substances contained in the bilge and ballast waters of ships and the improper disposal of hazardous wastes and materials contribute to the risk of environmental damage. Environmental damage includes soil contamination, soil erosion, water pollution, contamination of coastal regions and subsequent biodiversity loss such as the destruction of vast areas of mangroves, air pollution, and threats to plant and animal health. Since reliable data do not exist on the full scope and nature of the problem in Alang and Chittagong, it is not possible to estimate the actual environmental damage (see, e.g., Basha et al., 2007; Demaria, 2010:256; Greenpeace, 2001; Hossain and Islam, 2006:18-32; Puthucherril,

2011:288; Reddy et al., 2005; World Bank, 2010:33-37). Such damage is a serious problem because it can deplete important natural resources, disrupt the stability of larger ecosystems, and threaten human health and the livelihoods of farmers and fishers in surrounding villages (Demaria, 2010). And, of course, hazardous materials are carried outside the yards by equipment and other materials are taken off the ships and reused elsewhere. Steel re-rolling mills disperse toxic materials into the atmosphere through heating steel coated with toxic materials. Rising sea levels resulting from climate change may increase environmental damage by washing out “legacy pollution” on the beaches of the breaking yards (World Bank, 2010:38-39).

Human Health and Safety Risks

Occupational and environmental exposure to the hazards posed by ship breaking and the attendant health consequences are not fully known, but those exposed are at a high risk of death, disease, and injury because of their increased susceptibility to various site-specific cancers, skin irritation, respiratory problems such as asbestosis, and neurobehavioral problems. Accidents are common and workers are at increased risk of death and injury from snapping cables, chemical spills, welding fumes, falls, falling objects, fires, and explosions (Demaria, 2010; Greenpeace International and International Federation for Human Rights, 2005; Hossain and Islam, 2006; Puthucherril, 2011:285-288; Rousmaniere and Raj, 2007; World Bank, 2010).

Since reliable data do not exist on the full occupational and environmental exposure to the emissions of hazardous substances in the yards, it is not possible to estimate the actual number of deaths or cases of disease and injury that can be attributed to them. It is quite clear, given what we know about the environmental risks discussed above, that health problems linked to ship breaking are pervasive. Air pollution and water contamination have been well documented

(Basha et al. 2007; Reddy et al., 2005). Hazardous waste management is also a problem, for hazardous wastes are dumped in a haphazard fashion (Demaria, 2010; Puthucherril, 2010, 2011). Accidents and the adverse health and safety conditions facing workers and the inhabitants of the areas surrounding the yards are serious (Greenpeace International and International Federation for Human Rights, 2005; International Federation for Human Rights and Young Power in Social Action, 2008; World Bank, 2010).

Adverse health effects have been reported by a number of researchers (Greenpeace International, 2001; Greenpeace International and International Federation for Human Rights, 2005; World Bank, 2010;). The conditions are so severe that "...a doctor at the Red Cross Hospital in Alang [is reported to have said that] working one day in the ship breaking yards is equal to smoking 10-15 packs of cigarettes" (Greenpeace International and International Federation for Human Rights, 2005:10). Reliable data on the number of accidental deaths and future deaths resulting from diseases with long latency periods such as asbestosis are not available. Estimates indicate that one in every six workers may have asbestosis and workers are at inflated risk of lung and related forms of cancer (Greenpeace International and International Federation for Human Rights, 2005). Greenpeace International and International Federation for Human Rights (2005) estimate that thousands of workers have died in the last several decades and thousands are at risk in the future.

Communicable diseases are also a problem in the yards. One researcher described the situation in Alang in the following way:

The labourers in Alang live in poor housing and sanitary conditions and little attention is paid to their health and safety concerns. According to the physicians in and around Alang who treat numerous Alang patients, the combination of hazardous

working conditions, congested and unhygienic living conditions, poor drinking water, (...) and rampant prostitution have given rise to a number of skin, gastrointestinal, and liver diseases besides tuberculosis, leprosy, malaria, malnutrition, cancer, HIV/AIDS, and other sexually transmitted diseases (cited in Greenpeace International and International Federation for Human Rights, 2005:11).

The stories of a number of workers who were injured or killed in the breaking yards of Alang and Chittagong are included in a 2005 report by Greenpeace International and the International Federation for Human Rights (2005). Several of these “witness stories” from Alang and Chittagong are quoted at length to illustrate the seriousness of the problem:

Alang, India

- Bhaskar Zena was 35 when he was burnt alive at plot no. 17. His family in Nuashai did not get any compensation (Greenpeace International and International Federation for Human Rights, 2005:37).
- My name is Ramhari. I am 53 years old and I have lived in Dudurapada hamlet of Adapada village all of my life, except for the four black months in Alang. There are about 3,000 households in my village and about 1,000 young people have migrated to Alang looking for a job. Out of sheer poverty I also left for Alang looking for a job. I was desperate after one of my sons died of a snakebite.

I stayed in Alang for a few months, not aware of what could happen to me.

One morning a major catastrophe struck me and my family. I was working on the deck of a ship beached at plot no. 49. Somebody dropped a large iron ball, which struck my head. I fell unconscious and was brought to the hospital, but

I did know how long I stayed there. Maybe two or three months. I wasn't aware of my condition, but gradually I found out that my left arm was fully paralysed.

I encountered a great hardship with my family and was compelled to start begging. Our lives have become extremely miserable. Since the accident I have lost six children due to various illnesses. I tried my best to obtain some kind of treatment for them, but it didn't work as I didn't have enough money. I undertook several things, basically washing dishes in small hotels, to feed my family.

My wife couldn't bear all this and she has since become mentally ill. How could one bear so much loss? I don't remember everything clearly, because I was grief stricken. My mind was in one place and my body somewhere else. After the incident, they paid me 3,000 rupees (60 euros) plus some money for medical treatment. I knew that the money given to me was meager, but I couldn't do anything. How can I fight in an alien place where I know nothing and nobody? The money didn't last long. Now I am forced to beg, due to the ship breaking work.

In the last 15 or 16 years life has given me nothing but sorrow, pain and suffering. At present I earn 500 to 600 rupees per month by washing plates in Kunkudaakhandi. My wife has been ill for a long time. Yes, quite often I remember my lost children, and this brings tears to my eyes. But what can I do? I always curse the time I was forced to go to Alang (Greenpeace International and International Federation for Human Rights, 2005:30).

Chittagong, Bangladesh

- Shorab died in July 1998 while he was lifting an oxygen bottle, used for gas cutting, onto a ship. The rope broke and the bottle fell on his chest. He fell in the muddy water. Two hours later his fellow workers found his body (Greenpeace International and International Federation for Human Rights, 2005:21).
- [Muhun a]... 36-year old cutter from Sylhet was injured during the major explosion on the TT Dina oil tanker on 31 May 2000 in Chittagong. This explosion killed 16 workers and left 40 people injured. Muhun escaped death on that occasion, but three years later he suffered another blast that left him paralysed (Greenpeace International and International Federation for Human Rights, 2005:29).

Economic Costs

The economic costs associated with the cleanup of contaminated sites in Alang and Chittagong, as well as the surrounding communities and beyond are high. The treatment and compensation of the victims of hazardous exposures are potentially very costly. Destruction of marine life and the livelihoods of fishers, mangroves, biodiversity, soil and the livelihoods of farmers, water and air quality, and other natural resources is also likely to be costly. Reductions in human health are costly, and they can impede future economic growth (Price-Smith 2001). These and other tangible and intangible economic costs associated with the transfer of this particular hazardous industry appear to be substantial (Demaria, 2010; Rousmaniere and Raj, 2007; World Bank, 2010).

Social Costs

Contrary to Ulrich Beck 's (1992, 1999) "risk-society" thesis, most of the costs or risks associated with the transfer of ship breaking to the beaches of Bangladesh and India are distributed in an unequal fashion (see Frey, 2006a). (11) In other words, most of the benefits go to the core-based TNCs who control shipping and the brokers and breakers who profit from the sale of the ships, while Bangladesh and India bear most of the costs. Losses are distributed in an unequal fashion within Bangladesh and India: some groups (especially the state and local capital) are able to capture the benefits and other groups (those marginalized by age, class, race/ethnicity, and geographic location, including workers and their families as well as those in surrounding communities) bear the costs (Greenpeace International and International Federation for Human Rights, 2005; International Federation for Human Rights and Young Power in Social Action, 2008; World Bank, 2010).

AN APPROXIMATE ANALYSIS OF COSTS AND BENEFITS

Are the costs associated with the displacement of ship breaking to countries like Bangladesh and India offset by the economic and other benefits as proponents of neoliberalism (Grossman and Krueger, 1993, 1995) and ecological modernization theorists (Mol, 2001) suggest? After all, ship breaking employs thousands of poor workers desperate for jobs in Bangladesh, India, and elsewhere. The steel recovered from the ships is recycled and used domestically in road and building construction which reduces the environmental and health impacts of mining and reduces energy use; the yards supply upwards of 80% of Bangladesh's steel and upwards of 15% of India's steel at half the price of furnace produced steel (Demaria, 2007; International Federation for Human Rights, 2002; Hossain and Islam, 2006; Rousmaniere and Raj, 2007; World Bank, 2010). In addition, import duties and other fees on incoming ships provide revenue for the state

and the recycled steel is an important material in building and road construction.

Answering the question raised above as noted elsewhere (Frey, 2006a, 2012a) is problematic because it is difficult to identify, estimate, and value the costs and benefits (especially the costs) associated with hazards in monetary terms (see, e.g., Frey, McCormick, and Rosa, 2007).

Despite suggestions and efforts to the contrary (e.g., Logan, 1991), there is no widely accepted factual or methodological basis for identifying, estimating, and valuing the costs and benefits associated with the flow of core hazards to the periphery. Even if the consequences of hazardous exports could be meaningfully identified and estimated, there remains the question of valuing them in monetary terms. Economists typically look to the marketplace for such a valuation, but adverse health, safety, environmental, and socio-economic consequences are not traded in the marketplace. Efforts have been made to deal with this problem by using either expert judgment or public preferences (Mitchell and Carson, 1989), but such techniques are deeply flawed (see Dietz, Frey, and Rosa, 2002; Foster, 2002a).

Comments contained in the often cited 1991 memo by former World Bank Chief Economist Lawrence Summers (1992) are worth quoting at length because they illustrate the difficulties and contradictory outcomes of applying traditional economic reasoning to the transfer of hazardous industries and wastes like ship breaking to the periphery. Sounding a bit like Marie Antoinette, Summers notes:

Just between you and me, shouldn't the World Bank be encouraging *more* migration of the dirty industries to the LDCs? I can think of three reasons:

- (1) The measurement of the costs of health-impairing pollution depends on the forgone earnings from increased morbidity and mortality. From this point of view

a given amount of health-impairing pollution should be done in the country with the lowest cost, which will be the country with the lowest wages.

(2) The costs of pollution are likely to be non-linear as the initial increments of pollution probably have been very low cost. I've always thought that under-populated countries in Africa are vastly under-polluted; their air quality is probably vastly inefficiently low compared to Los Angeles or Mexico City....

(3) The demand for a clean environment for aesthetic and health reasons is likely to have very high income-elasticity. The concern over an agent that causes a one-in-a-million chance in the odds of prostate cancer is obviously going to be much higher in a country where people survive to get prostate cancer than in a country where under-5 mortality is 200 per thousand. Also, much of the concern over industrial atmosphere discharge is about visibility of particulates. These discharges may have little direct health impact. Clearly trade in goods that embody aesthetic pollution concerns could be welfare enhancing. While production is mobile the consumption of pretty air is a non-tradable.

The editors of *The Economist* (2007:14) magazine based in London made a similar argument more recently:

...the best way of recycling waste may well be to sell it, often to emerging markets. That is controversial, because of the suspicion that waste will be dumped, or that workers and the environment will be poorly protected. Yet recycling has economics of scale and the transport can be virtually free--filling up the containers that came to the West full of clothes and electronics and would otherwise return empty to China. What's more, those who are prepared to buy

waste are likely to make good use of it.

As noted elsewhere (Frey, 2006a), such reasoning undervalues nature and assumes that human life in the periphery is worth much less than in the core because of wage differentials (see also Foster 2002b; Harvey, 1996:368). Although most costs occur in the periphery and most benefits are captured by the core and elites located in the periphery, the costs to the periphery are deemed acceptable because life is defined as worth so little. (12) In sum, it can be argued that the costs associated with the transfer of ship breaking to Chittagong, Bangladesh and Alang, India outweigh the benefits.

WHAT CAN BE DONE? AND WHO SHOULD DO IT?

The image of ghost ships sailing for the breaking yards on the beaches of India and Bangladesh is a disturbing one. Unlike the Flying Dutchman, however, many of these ships have been and will be beached and broken with adverse health, safety, environmental, and socio-economic consequences. The displacement of ship breaking to the beaches in Bangladesh and India can be framed as racist (Bullard et al., 2005; Pellow, 2007:37ff; Puthucherril, 2010:51), but it represents something more. It reflects the unequal power relations underlying interaction patterns between countries occupying different positions in the world-system. Centrality in the world-system allows countries to engage in Not-In-My-Backyard (NIMBY) behavior (or what we might refer to as “*ecological modernization*” behavior) and impose their entropy on the periphery.

Efforts to curb the adverse consequences associated with ship breaking in Bangladesh and India and hazardous industries located throughout the periphery have taken a wide variety of forms: various national regulatory efforts; bilateral and multilateral environmental agreements; various international conventions, including the Basel Convention on the Control of

Transboundary Movements of Hazardous Wastes and their Disposal and the Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships adopted in May 2009 under the auspices of the International Maritime Organization, that becomes effective in 2015 (see European Commission DG Environment, 2009; Frey, 2006a; Karim, 2010; Moen, 2008; Okereke, 2008:80-98; Puthucherril, 2010, 2011); codes of conduct such as the International Chamber of Shipping Industry Code of Practice on Ship Recycling; and a range of trade treaties (see, e.g., Demaria, 2007; Greenpeace International and International Federation for Human Rights, 2005; Hossain and Islam, 2006; International Federation for Human Rights, 2002; Okereke, 2008; Puthucherril, 2010: Chapters 3-5, 2011; Rousmaniere and Raj, 2007; World Bank, 2010). These efforts to “globalize responsibility” are problematic because of noncompliance and weak implementation and enforcement capacity at the national and supranational levels, resulting from a fragmentation of efforts, limited resources, increased capital mobility, and the neoliberal project that frames regulation as a trade barrier (see Frey, 1998a, 2006a, 2006b; Greenpeace International and International Federation for Human Rights, 2005; Karim, 2010). (13)

Several analysts have called for more stringent measures, including “the renationalization of capital” (Daly 1996:145-162) or the dismantling of what Gould et al. (1996, 2008) call the “transnational treadmill of production.” Implementation of these latter proposals appears unlikely given the structural constraints posed by the current world-system. In effect, stopping the displacement of hazards or environmental harms (as noted elsewhere [Frey, 2006a]) through the “globalization of responsibility” or the “renationalization of capital” is unlikely as long as the core countries control a majority of the wealth generated in the world-system.

What is being done to challenge ship breaking as it is currently practiced in the world-system? Several organizational and political changes are currently underway. Non-governmental organizations (NGOs, including Bangladesh Environmental Lawyers Association [BELA], Toxic Links, Human Rights Law Network, and Young Power in Social Action) have pressured state authorities in Bangladesh and India to develop and enforce higher standards and open the policy discourse to the public about toxic wastes (Demaria, 2010; Rousmaniere and Raj, 2007). Several labor organizations (e.g., Alang Recycling and General Workers' Association) have sponsored strikes for better wages and working conditions. International NGOs such as Greenpeace International and the Basel Action Network have begun to monitor and study actual conditions in and around the yards, as well as pressure yard owners and state agents to change operating procedures (see, e.g., Demaria, 2010; Greenpeace International, 2000, 2001; Greenpeace International and International Federation for Human Rights, 2005; Rousmaniere and Raj, 2007). Greenpeace International, the Basel Action Network, the Ship Breaking Platform, and other organizations (such as the International Maritime Organization, the International Labour Organization, International Metalworkers Federation, the European Commission Director General of the Environment, and the United Nations Environment Programme) as well as many analysts have made a number of specific recommendations (European Commission Director General of the Environment, 2009; International Federation for Human Rights, 2002; Greenpeace International and International Federation for Human Rights, 2005; Hossain and Islam, 2006; Puthucherril, 2010; 2011:191-207). These include:

- Ship breaking yards should be open to inspection by NGOs, trade unions, and other groups.
- Operating ships should be made cleaner through maintenance and retrofitting.

- A global regulatory regime should be developed and fully implemented to regulate ship breaking.
- The next generation of ships should be constructed to reduce health, safety, and environmental impacts at the time of decommissioning.
- Ship owners and flag state holders should be responsible for the clean and safe dismantling of ships.
- Workers should be protected through improved safety practices in the yards.

Economic globalization and the attendant adverse consequences have clearly fostered counter-hegemonic forces or anti-systemic movements in the form of transnational networks of NGOs as noted above (Frey, 2006a). The extent to which national and transnational NGOs will actually curb the adverse consequences of economic globalization in India, Bangladesh, and elsewhere is the subject of much debate (see, e.g., Chase-Dunn, 2010; Evans, 2000; Mol, 2001; Pellow, 2007: Chapters 3 and 7; Wallerstein, 2002). Counter-hegemonic globalization in the form of transnational networks of NGOs (often referred to as “globalization from below”) remains one of the more viable means for curbing some of the adverse consequences associated with the transfer of hazardous production processes (whether ship breaking, computer dismantling, battery recycling, or otherwise) to “sacrifice zones” (14) located in the periphery (see also Frey, 2012a; Gould et al., 2008:103-104; Pellow, 2007). Stopping the core 's appropriation of the periphery's carrying capacity or “environmental space” is another matter, for that is embedded in the very structure of the current world-system (Wallerstein, 2004). And the process of “ecological unequal exchange” is necessary for continued capital accumulation in the core as noted at the beginning of this paper. (15)

CONCLUSIONS

What this article brings into sharp focus is the ecological contradictions of globalization and the current world-system. To be more specific, it contributes to the emerging literature on ecological unequal exchange and what some have called the exploitation of environmental space by the advanced capitalist center. Much of the existing literature has focused on the extraction of wealth from the “resource frontiers” located in the peripheral zones of the world-system. The ship breaking case reported here represents an important example of the displacement of the core’s anti-wealth to the “waste disposal frontiers” of the periphery and the resulting adverse health, safety, environmental, and socio-economic consequences for the periphery. Ship breaking illustrates quite clearly that capital accumulation in the core is dependent on peripheral contamination.

Much more research is needed on core capital accumulation through peripheral contamination and the process of ecological unequal exchange. Future research should look at the full range of hazardous production practices and wastes that are displaced to the “waste disposal frontiers.” One direction for future research should be the examination of the movement of the core’s hazardous production practices to the more than 3,500 export processing zones located in less developed countries scattered throughout Asia, Africa, Latin America, and the Caribbean (Dicken, 2011:193). These free zones have limited regulatory restrictions on hazardous production practices and waste disposal and offer many other concessions to core capital that facilitate capital accumulation. The zones represent an increasingly important feature of the expanding metabolic rift in the world-system and need to be more fully addressed in efforts to understand ecological unequal exchange relationships between core and periphery.

ENDNOTES

1. See especially Wallerstein (1976-2011, 2000, 2004) for the origins and nature of the world-system perspective and Harvey (2010) for a recent discussion of continuous capital accumulation under capitalist relations in the global economy.
2. This is not only a recent process (Bunker, 1985; Bunker and Ciccantell, 2005; Hornborg, 2011), but a historical process that gave rise to the first core nations in Europe and modern global capitalism (Moore, 2010a, 2010b; Robins, 2011).
3. See Faber (2008, 2009) for a recent restatement of much of the earlier work by Frey (1998a, 1998b, 2006a) and others (Clapp, 2001).
4. Shortly before completing an earlier draft of this paper, I discovered Demaria's (2010) insightful paper on ship breaking in Alang, India. Although we take different approaches and he confines his attention to Alang, I have incorporated several important elements from the Demaria paper that are noted in the text.
5. See Hornborg (1998, 2009, 2011), Jorgenson and Clark (2009), and Rice (2007, 2009) for detailed discussions of the process of ecological unequal exchange in which the core extracts energy and material from the periphery and exports entropy to the periphery. Harvey (2010) provides a recent discussion of capital accumulation, which has much relevance for world-systems theory and the processes of ecological unequal exchange.
6. The global shipping industry has grown dramatically since the 1960s. This growth is in large part a result of the development of standardized shipping containers (see Levinson, 2006). These containers have facilitated efficient and effective transport of goods in the world-system. Individual container ships carry thousands of tons of freight and travel more than two hundred thousand miles each year. See American Association of Port Authorities (2008) for data on total

cargo volume and container traffic at world ports in the world-system. Halpern et al. (2008) present estimates of the environmental impact of the shipping industry and other human activities on marine ecosystems around the world. And Shin and Ciccantell (2009) provide an excellent overview of the changing nature and location of shipbuilding in the world-system.

7. Ecological modernization theorists (e.g., Mol 2001) maintain that highly developed countries are adept at dealing with their environmental problems because of increased public concern with the environment, the economic means, and increased environmental regulation. One of the ironies surrounding the ecological modernization perspective is that the highly developed countries do often deal with their environmental harms effectively, but they do so by displacing them to countries located in the peripheral zones of the world-system. See York and Rosa (2003) for a theoretical and empirical critique of the ecological modernization perspective. Of course, the movement of ship breaking to the periphery (and the movement of other hazards) from the core to the periphery) can be framed as a manifestation of ecological modernization processes.

8. An extensive research literature has emerged on the “pollution haven” debate or the thesis that many of the core’s core hazardous industries move to the periphery to escape environmental regulation (see Frey, 1998b, 2006a; Muradian and Giljum, 2007). See Clapp (2002) for an older but nonetheless relevant critical review of the literature, much of which has been conducted by neo-liberal economists. Clapp (2002:11-13) is highly critical of this research and notes that the hazardous waste management industry (that includes industries like ship breaking, e-waste recycling, and the like) has not been the subject of research by neo-liberal economists.

9. The International Federation for Human Rights and Young Power in Social Action (2008:7) report that 25% of the workers in Chittagong are under the age of 18, some as young as 12. They

identify the main cause of child labor to be poverty and debt, resulting from a family's loss of land, disappearance of a father, the cost of a wedding, or some combination of the three.

10. But see Demaria's (2010:256-259) discussion of the Indian Supreme Court and the "Blue Lady" case and the Bangladeshi Supreme Court's 2010 restrictions on ship breaking in Chittagong (Anonymous, 2011). See also Karim (2010) for additional discussion of the issue.

11. See the recent statement of Alario and Freudenburg (2010) who use the analogy of the Titanic sinking in their discussion of the unequal distribution of risks in the "risk-society."

12. Or, as Herman Daly (1993:57) has noted: "By separating the costs and benefits of environmental exploitation, international trade makes them harder to compare." To put it another way, the "metabolic rift" between the core and periphery (Foster, Clark, and York, 2010; see also Moore, 2000, 2011) is made invisible by globalization and the attendant market ideology espoused by proponents of the neo-liberal perspective and ecological modernization.

13. See Puthucherril's (2010, 2011) detailed and critical discussion of the ambitious Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships and other efforts to curb the risks associated with ship breaking. See also Karim's (2010) excellent discussion.

14. To borrow a term from Lerner's (2010) recent discussion of environmental injustice in the United States.

15. Puthucherril (2010:12) is much more optimistic. He notes "... international standards for ship recycling, along with greater North-South cooperation, are necessary to ensure sustainable ship recycling."

REFERENCES

- Alario, Margarita V. and William R. Freudenburg. 2010. "Titanic Risks Are Not So Titanic After All." *Sociological Inquiry* 80:500-512.
- American Association of Port Authorities. 2008. "World Port Rankings 2008." Available at www.aapa-ports.org/Industry/.
- Anonymous. 2008. "Alang Loses Out to Bangladesh." *Seatrade Asia Online* (August 28).
- _____. 2011. "Scrap Ship Import Gets Further Extension." *The Daily Star (Online Report July 21)*.
- Auyero, Javier and Debora Alejandra Swistun. 2009. *Flammable: Environmental Suffering in an Argentine Shantytown*. New York: Oxford University Press.
- Basha, Shaik, Premsingh Mansingh Gaur, Ravikumar Bhagwan Thorat, Rohitkumar Harikrishna Trivedi, Sandip Kumar Mukhopadhyay, Nisha Anand, Shalin Hemantbhai Desai, Kalpana Hareesh Mody, and Bhavnath Jha. 2007. "Heavy Metal Content of Suspended Particulate Matter at World's Largest Ship-Breaking Yard, Alang-Sosiya, India." *Water, Air, and Soil Pollution* 178:373-384.
- Beck, Ulrich. 1992. *Risk Society: Towards a New Modernity*. London: Sage.
- _____. 1999. *World Risk Society*. Malden, MA: Blackwell.
- Buerk, Roland. 2006. *Breaking Ships: How Supertankers and Cargo Ships Are Dismantled on the Shores of Bangladesh*. New York: Chamberlain Brothers.
- Bullard, Robert D., Glenn S. Johnson, and Angel O. Torres. 2005. "Addressing Global Poverty, Pollution, and Human Rights." Pp. 279-297 in *The Quest for Environmental Justice: Human Rights and the Politics of Pollution*, edited by Robert D. Bullard. San Francisco: Sierra Books.

- Bunker, Stephen G. 1985. *Underdeveloping the Amazon: Extraction, Unequal Exchange, and the Failure of the Modern State*. Urbana: University of Illinois Press.
- _____. 2007. "Natural Values and the Physical Inevitability of Uneven Development under Capitalism." Pp. 239-258 in *Rethinking Environmental History: World-System History and Global Environmental Change*, edited by Alf Hornborg, J.R. McNeill, and Joan Martinez-Alier. New York: AltaMira Press.
- Bunker, Stephen G. and Paul S. Ciccantell. 2005. *Globalization and the Race for Resources*. Baltimore, MD: The Johns Hopkins University Press.
- Chase-Dunn, Christopher. 2010. "Globalization from Below: Toward a Democratic Global Commonwealth." *Journal of Globalization Studies* 1:46-57.
- Clapp, Jennifer. 2001. *Toxic Exports: The Transfer of Hazardous Wastes from Rich to Poor Countries*. Ithaca, NY: Cornell University Press.
- _____. 2002. "What the Pollution Haven Debate Overlooks." *Global Environmental Politics* 2:11-19.
- Clark, Brett and John Bellamy Foster. 2009. "Ecological Imperialism and the Global Metabolic Rift: Unequal Exchange and the Guano/Nitrates Trade." *International Journal of Comparative Sociology* 50:311-334.
- Daly, Herman. 1993. "The Perils of Free Trade." *Scientific American* 262:50-57.
- _____. 1996. *Beyond Growth: The Economics of Sustainable Development*. Boston: Beacon Press.
- Demaria, Federico. 2010. "Shipbreaking at Alang-Sosiya (India): An Ecological Distribution Conflict." *Ecological Economics* 70:250-260.

- Dick, Christopher and Andrew K, Jorgenson. 2011. "Capital Movements and Environmental Harms." *Journal of World-Systems Research* 37:482-497.
- Dicken, Peter. 2011. *Global Shift: Mapping the Contours of the World Economy*. New York: Guilford Press.
- Dietz, Thomas and Eugene A. Rosa. 1997. "Effects of Population and Affluence on CO2 Emissions." *Proceedings of the National Academy of Sciences of the USA* 94:175-179.
- Dietz, Thomas, R. Scott Frey, and Eugene Rosa. 2002. "Technology, Risk, and Society." Pp. 329-369 in *Handbook of Environmental Sociology*, edited by Riley Dunlap and William Michelson. Westport, CT: Greenwood Press.
- The Editors. 2007. Editorial. *The Economist* (June 9):14.
- European Commission DG Environment. 2009. *Support to the Impact Assessment of a New Legislative Proposal on Ship Dismantling*. Kongens Lyngby, Denmark: COWI.
- Evans, Peter. 2000. "Fighting Marginalization with Transnational Networks: Counter Hegemonic Globalization." *Contemporary Sociology* 29:230-241.
- Faber, Daniel. 2008. *Capitalizing on Environmental Injustice: The Polluter-Industrial Complex in the Age of Globalization*. Lanham, MD: Rowman and Littlefield.
- _____. 2009. "The Unfair Trade-off: Globalization and the Export of Ecological Hazards." Pp. 181-199 in *Environmental Sociology: From Analysis to Action*, edited by Leslie King and Deborah McCarty. Lanham, MD: Rowman and Littlefield.
- Foster, John Bellamy. 2002a. "The Ecological Tyranny of the Bottom Line: The Environmental and Social Consequences of Economic Reductionism." Pp. 26-43 in *Ecology Against Capitalism*, by John Bellamy Foster. New York: Monthly Review Press.
- _____. 2002b. "Let Them Eat Pollution: Capitalism in the World Environment." Pp. 60-

- 68 in *Ecology Against Capitalism*, by John Bellamy Foster. New York: Monthly Review Press.
- Foster, John Bellamy, Brett Clark, and Richard York. 2010. *The Ecological Rift: Capitalism's War on the Earth*. New York: Monthly Review Press.
- Frey, R. Scott. 1995. "The International Traffic in Pesticides." *Technological Forecasting and Social Change* 50:151-169.
- _____. 1998a. "The Hazardous Waste Stream in the World-System." Pp. 84-103 in *Space and Transport in the World-System*, edited by Paul Ciccantell and Stephen G. Bunker. Westport, CT: Greenwood Press.
- _____. 1998b. "The Export of Hazardous Industries to the Peripheral Zones of the World-System." *Journal of Developing Societies* 14:66-81.
- _____. 2006a "The Flow of Hazardous Exports in the World-System." Pp. 133-149 in *Globalization and the Environment*, edited by Andrew Jorgenson and Edward Kick. Leiden, The Netherlands and Boston: Brill Academic Press.
- _____. 2006b. "The International Traffic in Asbestos." *Nature, Society, and Thought* 19:173-180.
- _____. 2012a. "The E-Waste Stream in the World-System." *Journal of Globalization Studies*, In Press.
- _____. 2012b. "The Displacement of Hazardous Products, Production Processes, and Wastes in the World-System." In *Handbook of World-Systems Analysis: Theory and Research*, edited by Salvatore Babones and Christopher Chase-Dunn. New York: Routledge.
- Frey, R. Scott, Sabrina McCormick, and Eugene A. Rosa. 2007. "The Sociology of Risk." Pp.

- 81-87 in *The Handbook of 21st Century Sociology, Volume II*, edited by Clifton D. Bryant and Dennis Peck. Thousand Oaks, CA: Sage.
- Gould, Kenneth A., David N. Pellow, and Allan Schnaiberg. 2008. *The Treadmill of Production: Injustice and Unsustainability in the Global Economy*. Boulder, CO: Paradigm Publishers.
- Gould, Kenneth A., Allan Schnaiberg, and Adam S. Weinberg. 1996. *Local Environmental Struggles: Citizen Activism in the Treadmill of Production*. New York: Cambridge University Press.
- Greenpeace International. 2000. *Shipbreaking: A Global Environmental, Health, and Labour Challenge*. Amsterdam, The Netherland: Greenpeace International.
- _____. 2001. *Steel and Toxic Wastes for Asia: Findings of a Greenpeace Study on Workplace and Environmental Contamination in Alang-Sosiya Shipbreaking Yards, Gujarat, India*. Amsterdam, The Netherlands: Greenpeace International.
- Greenpeace International and International Federation for Human Rights. 2005. *End of Life Ships: The Human Cost of Breaking Ships*. Amsterdam, The Netherlands: Greenpeace International.
- Grineski, Sara E., Timothy W. Collins, Maria de Loures Romo Aguilar, and Raed Aldouri. 2010. "No Safe Place: Environmental Hazards and Injustice along Mexico's Northern Border." *Social Forces* 88:2241-2266.
- Grossman, Gene M. and Alan B. Krueger. 1993. "Environmental Impacts of a North America Free Trade Agreement." In *The Mexico-U.S. Free Trade Agreement*, edited by Peter M. Garber. Cambridge, MA: The MIT Press.
- _____. 1995. "Economic Growth and the Environment." *The Quarterly Journal of Economics*

110:350-377.

Halpern, Benjamin S. Shaun Walbridge, Kimberly A. Selkoe, Carrie V. Kappel, Fiorenza Micheli, Caterina D'Agrosa, John F. Bruno, Kenneth S. Casey, Colin Ebert, Helen E. Fox, Rod Fujita, Dennis Heinemann, Hunter S. Leniham, Elizabeth M.P. Madin, Matthew T. Perry, Elizabeth R. Selig, Mark Spalding, Robert Steneck, and Reg Watson. 2008. "A Global Map of Human Impact on Marine Ecosystems." *Science* 319 (15 February):948-952.

Harvey, David. 1996. *Justice, Nature and the Geography of Difference*. Malden, MA: Blackwell.

_____. 2010. *The Enigma of Capital and the Crises of Capitalism*. New York: Oxford University Press.

Hooks, Gregory and Chad L. Smith. In press, 2011. "The Treadmill of Destruction Goes Global: Anticipating the Environmental Impact of Militarism in the 21st Century." In *Stratocracy: Society and the Marketing of War in the Age of Neo-Militarism*, edited by Kostas Gouliamos and Christos Kassimeris.

Hornborg, Alf. 1998. "Towards an Ecological Theory of Unequal Exchange: Articulating World System Theory and Ecological Economics." *Ecological Economics* 25:127-136.

_____. 2009. "Zero-Sum Game: Challenges in Conceptualizing Environmental Load Displacement and Ecologically Unequal Exchange." *International Journal of Comparative Sociology* 50:237-262.

_____. 2011. *Global Ecology and Unequal Exchange: Fetishism in a Zero-Sum World*. New York: Routledge.

- Hossain, M. Maruf and Mohamamad Mahmudul Islam. 2006. *Ship Breaking Activities and Its Impact on the Coastal Zone of Chittagong, Bangladesh: Towards Sustainable Development*. Chittagong, Bangladesh: Young Power in Social Action.
- International Federation for Human Rights. 2002. *Where Do the 'Floating Dustbins' End Up?* Paris: International Federation for Human Rights.
- International Federation for Human Rights and Young Power in Social Action. 2008. *Childbreaking Yards: Child Labour in the Ship Recycling Industry in Bangladesh*. Paris: International Federation for Human Rights.
- International Maritime Association. 2011. *International Shipping Facts and Figures – Information Resources on Trade, Safety, Security, and the Environment*. London: International Maritime Association.
- Jorgenson, Andrew K. 2006. "Global Warming and the Neglected Greenhouse Gas: A Cross-National Study of the Social Causes of Methane Emissions Intensity, 1995." *Social Forces* 84:1779-1799.
- Jorgenson, Andrew and Brett Clark. 2009. "The Economy, Military, and Ecologically Unequal Relationships in Comparative Perspective: A Panel Study of the Ecological Footprints of Nations, 1975-2000." *Social Problems* 56:621-646.
- Karim, Md. Saiful. 2010. "Environmental Pollution from Shipbreaking Industry: International Law and National Legal Response." *Georgetown International Environmental Law Review* 22:185-240.
- Kentor, Jeffrey and Peter Grimes. 2006. "Foreign Investment Dependence and the

- Environment: A Global Perspective.” Pp. 61-77 in *Globalization and the Environment*, edited by Andrew Jorgenson and Edward Kick. Leiden, The Netherlands and Boston: Brill Academic Press.
- Langewiesche, William. 2004. *The Outlaw Sea: Chaos and Crime on the World's Oceans*. New York: North Point Press.
- Lerner, Steve. 2010. *Sacrifice Zones: The Front Lines of Toxic Chemical Exposure in the United States*. Cambridge, MA: MIT Press.
- Levinson, Marc. 2006. *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger*. Princeton: Princeton University Press.
- Logan, Bernard I. 1991. "An Assessment of the Environmental and Economic Implications of Toxic-Waste Disposal in Sub-Saharan Africa." *Journal of World Trade* 25:61-76
- Margai, Florence and Fatoumata B. Barry. 2011. “Global Geographies of Environmental Injustice and Health: A Case Study of Illegal Hazardous Waste Dumping in Côte d’Ivoire.” Pp. 257-281 in Julianna A. Maantay and Sara McLafferty, editors. *Geospatial Analysis of Environmental Health*. New York: Springer.
- Martinez-Alier, Joan. 2007. “Marxism, Social Metabolism, and International Trade.” Pp. 221-237 in *Rethinking Environmental History: World-System History and Global Environmental Change*, edited by Alf Hornborg, J.R. McNeill, and Joan Martinez-Alier. New York: AltaMira Press.
- _____. 2009. “Social Metabolism, Ecological Distribution Conflicts, and Languages of Valuation.” *Capitalism Nature Socialism* 20:58-87.
- Mitchell, Robert Cameron and Richard T. Carson. 1989. *Using Surveys to Value Public Goods: The Contingent Valuation Method*. Washington, D.C.: Resources for the Future.

- Moen, Amy. 2008. "Breaking Basel: The Elements of the Basel Convention and its Application to Toxic Ships." *Marine Policy* 32:1053-1062.
- Mol, Arthur P. 2001. *Globalization and Environmental Reform: The Ecological Modernization of the Global Economy*. Cambridge, MA: MIT Press.
- Moore, Jason W. 2000. "Environmental Crises and the Metabolic Rift in World-Historical Perspective." *Organization and Environment* 13:123-157.
- _____. 2007. "Silver, Ecology, and the Origins of the Modern World, 1450-1640." Pp. 123-142 in *Rethinking Environmental History: World-System History and Global Environmental Change*, edited by Alf Hornborg, J.R. McNeill, and Joan Martinez-Alier. New York: AltaMira Press.
- _____. 2010a. "'Amsterdam is Standing on Norway' Part I: The Alchemy of Capital, Empire and Nature in the Diaspora of Silver, 1545-1648." *Journal of Agrarian Change* 10:33-68.
- _____. 2010b. "'Amsterdam is Standing on Norway' Part II: The Global North Atlantic in the Ecological Revolution of the Long Seventeenth Century." *Journal of Agrarian Change* 10:188-227.
- _____. 2011. "Transcending the Metabolic Rift: A Theory of Crises in the Capitalist World-Ecology." *The Journal of Peasant Studies* 38:1-46.
- Muradian, Roldan and Stefan Giljum. 2007. "Physical Trade Flows of Pollution-Intensive Products: Historical Trends in Europe and the World." Pp. 307-325 in *Rethinking Environmental History: World-System History and Global Environmental Change*, edited by Alf Hornborg, J.R. McNeill, and Joan Martinez-Alier. New York: AltaMira Press.
- Okereke, Chukwumerije. 2008. *Global Justice and Neoliberal Environmental Governance:*

- Ethics, Sustainable Development and International Cooperation*. London and New York: Routledge.
- Pellow, David Naguib. 2007. *Resisting Global Toxins: Transnational Movements for Environmental Justice*. Cambridge, MA: MIT Press.
- Prew, Paul. 2010. "World-Economy Centrality and Carbon Dioxide Emissions; A New Look at Position in the Capitalist World-System and Environmental Pollution." *Journal of World-Systems Research* 16:162-191.
- Price-Smith, Andrew T. 2001. *The Health of Nations: Infectious Diseases, Environmental Change and the Effects of National Security and Development*. Cambridge, MA: MIT Press.
- Puthucherril, Tony George. 2010. *From Shipbreaking to Sustainable Ship Recycling: Evolution of a Legal Regime*. Leiden and Boston: Martinus Nijhoff.
- _____. 2011. "Trans-boundary Movement of Hazardous Ships for their Last Rites: Will the Ship Recycling Conventions Make a Difference." *Ocean Yearbook* 24:283-330.
- Reddy, M. Srinivasa, Shaik Basha, H.V. Joshi, and G. Ramachandraiah. 2005. "Seasonal Distribution and Contamination Levels of Total PHCs, PAHs and Heavy Metals in Coastal Waters of the Alang-Sosiya Ship Scrapping Yard, Gulf of Cambay, India." *Chemosphere* 61:1587-1593.
- Rice, James. 2007. "Ecological Unequal Exchange: International Trade and Uneven Utilization of Environmental Space in the World System." *Social Forces* 85:1369-1392.
- _____. 2009. "The Transnational Organization of Production and Uneven Environmental Degradation and Change in the World Economy." *Journal of Comparative International Sociology* 50:215-236.

_____. 2011. “The Global Reorganization and Revitalization of the Asbestos Industry, 1970-2007.” *International Journal of Health Sciences* 41:239-254.

Roberts, J. Timmons, Peter Grimes, and Jodie Manale. 2006. “Social Roots of Global Environmental Change: A World-Systems Analysis of Carbon Dioxide Emissions.” Pp. 79-117 in *Globalization and the Environment*, edited by Andrew Jorgenson and Edward Kick. Leiden, The Netherlands and Boston: Brill Academic Press.

Roberts, J. Timmons and Bradley C. Parks. 2007. *A Climate of Injustice: Global Inequality, North-South Politics, and Climate Policy*. Cambridge, MA: MIT Press

Robindebois.org. 2008. *Special issue. Global statement 2008 of ships sent to demolition*.

Available at www.robindesbois.org.

_____. 2009. *Special issue. Global statement of 2007 ships sent to demolition*. Available at

www.robindesbois.org.

_____. 2010. *2009 Collection. Shipbreaking.com #15 to 18 – Ships sent to demolition from January 1st to decembre 31st*. Available at www.robindesbois.org.

_____. 2011. *2010 Collection. Shipbreaking.com #19 to 22 – Ships sent to demolition from January 1 to decembre 31st*. Available at www.robindesbois.org.

Robins, Nicholas A. 2011. *Mercury, Mining, and Empire: The Human and Ecological Cost of Colonial Silver Mining in the Andes*. Bloomington and Indianapolis: Indiana University Press.

Rousmaniere, Peter and Nikhil Raj. 2007. “Shipbreaking in the Developing World: Problems and Prospects.” *International Journal of Occupational and Environmental Health* 13:359-368.

Shin, Kyoung-ho and Paul S. Ciccantell. 2009 “The Steel and Shipbuilding Industries of South

- Korea: Rising East Asia and Globalization.” *Journal of World Systems Research* 15:167-192.
- Summers, Lawrence. 1991. Selections from a World Bank Memo. *The Economist* (February 8):66.
- Wallerstein, Immanuel. 1974-2011. *The Modern World System*. (4 Volumes.) New York: Academic Press.
- _____. 2000. *The Essential Wallerstein*. New York: The New Press.
- _____. 2002. "New Revolts Against the System." *New Left Review* 18 (November-December):29-39.
- _____. 2004. *World-Systems Analysis: An Introduction*. Durham, NC: Duke University.
- World Bank. 2010. *Ship Breaking and Recycling Industry in Bangladesh and Pakistan*. Washington, D.C.: World Bank.
- York, Richard and Eugene A. Rosa. 2003. “Key Challenges to Ecological Modernization Theory.” *Organization and Environment* 16:273-288.
- York, Richard, Eugene A. Rosa, and Thomas Dietz. 2003. “A Rift in Modernity? Assessing the Anthropogenic Sources of Global Climate Change with the STIRPAT Model.” *International Journal of Sociology and Social Policy* 23: 31-51.
- York, Richard and Eugene A. Rosa. 2006. “Emissions of Sulphur Dioxide and Nitrogen Oxides.” Pp. 119-132 in *Globalization and the Environment*, edited by Andrew Jorgenson and Edward Kick. Leiden, The Netherlands and Boston: Brill Academic Press.

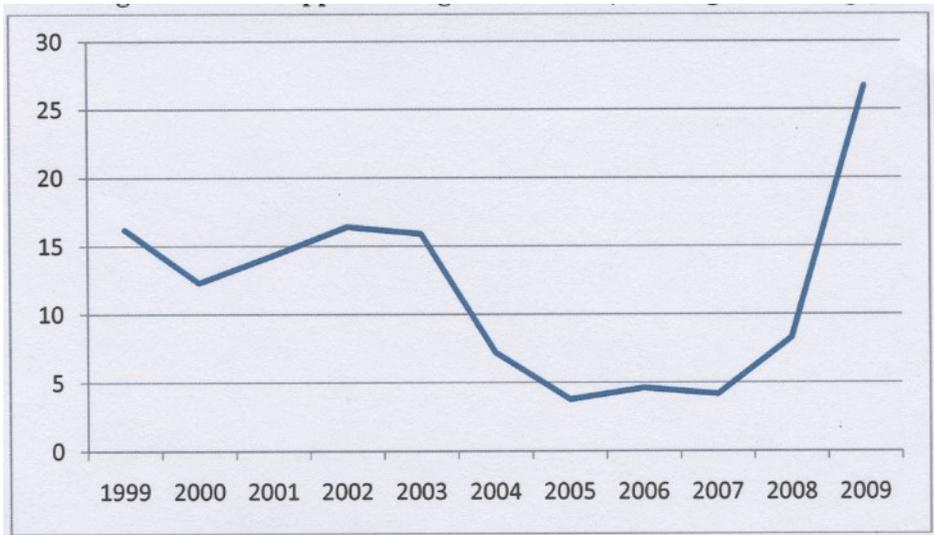


Figure 1. Global Ship Breaking Activity, 1999-2009 (million gross tons)

SOURCE: World Bank (2010:3)



SOURCE: ESRI

MSNBC

Figure 2. Location of Shipyards in India and Bangladesh

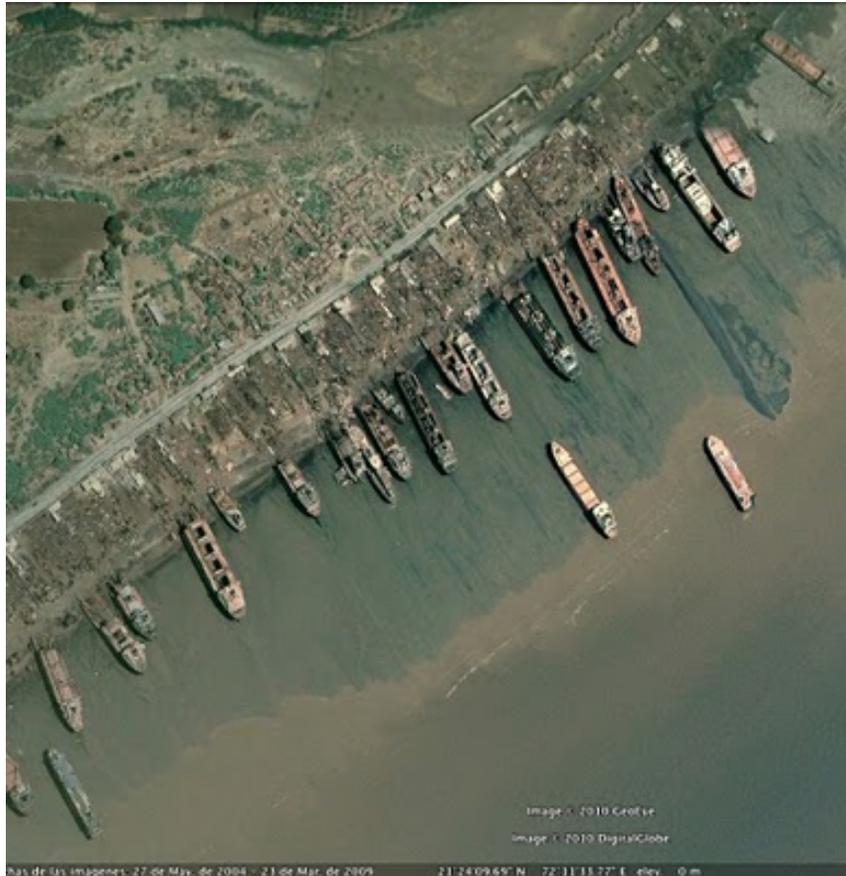


Figure 3. Ship Breaking Yard in Alang, India

SOURCE: Google Map