A Comparison of Environmental Assessment (EA) Prediction Practices for Offshore Oil and Gas in Canada and Nigeria: How do they compare to best practices in EA literature in relation to seabirds and marine vertebrates?

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Abstract

Anthropogenic economic activities are progressively harming the ocean environment. This is true of the oil and gas sector, which has increased in scale, and is a major driver of the offshore economy. Oceans are severally polluted, as a result, through vessels accidents, accidental spills and large oil spill. There is also the challenge posed by seismic activities and operational installations associated with offshore oil and gas projects. Evidently, offshore oil and gas operations levy extensive impacts on seabirds and marine vertebrates, and the totality of the marine environment. The goal of Environment Assessment (EA) is to predict project environmental impacts with a reasonable degree of certainty. In the offshore oil and gas sector of most jurisdictions, EA is a compulsory requirement for project approvals. This paper considered the EA prediction practices of Canada and Nigeria. In the process, the Environmental Impact Statements (EIS) of the Terra Nova and Hebron offshore oil projects in Newfoundland and Labrador, Canada and the Diebu Creek and Jones Creek Nearshore oil projects of the Niger-Delta of Nigeria, were analyzed and compared. The objective was to investigate the EA prediction processes of these two countries and how they met best practices, in relation to predictions on seabirds and turtles. The paper concludes with a critical evaluation of the performance of the sampled EIS documents. The outcome of the analysis indicated a weaker EA prediction regime in Nigeria. The Canadian counterpart appeared stronger in its adaptation to best practices, although there are gaps in the process, suggesting a necessity for improvement.

Foreword

The learning I underwent in the MES Planning program of York University challenged my views and beliefs, and expanded my knowledge of the components of my areas of concentration, which were environmental assessment, sustainable extraction, natural resource management, land use planning, corporate social responsibility and geographic information system. As a result, I am armed with enough practical tools to continue my exploration of the subject matter of environmental planning and sustainable extraction. This paper is the final submission for the Masters of Environmental Studies (Environmental Planning stream) program at the York University. With it, I reached the climax of this academic journey that spanned two years, and involved numerous class assignments, field trips and research work, including research papers.

The theme of this paper is directly connected to my Plan of study: environmental planning and sustainable extraction. Its focus is on a comparative analysis and evaluation of the environmental assessment predictions in Canada and Nigeria, in relation to seabirds and marine vertebrates. Therefore it addresses the learning objectives enunciated in my Plan of Study (POS). As I indicated above, this paper is yet another step in my upward march towards attaining academic heights beyond my present, and to sustain my education on the various principles and practices I learnt over the years on environmental planning and sustainable extraction.

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I start by thanking the Almighty God for his grace and provisions, which assisted me to complete this academic program. May HIS name be glorified now and forever more. Amen.

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Finally, I dedicate this to my mother, Elizabeth; my late father, Charles Sr.; and my siblings, including those that have passed to the great beyond. ‘Blood will always be thicker than water’, and family, for me, was the strong foundation and support system that I relied on to navigate through this program. And for that, I am grateful.

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Introduction

The overall essence of preventing and mitigating cumulative impacts of anthropogenic activities, which are constant in our extensively capitalist driven planet, is a function of the need to effect environmental stewardship and governance in the face of the inevitability of economic progression and development. So, stewardship is commonly expressed through community ethic, which is embraced to ensure the sustainable use and management of natural resources for the maintenance of better life for current and future generations (National Research Council, 2008). Similarly, governance is the social structure going beyond formal systems of government, that encompasses the values, mores, policies, laws, and institutions by which a society addresses a set of issues (ibid). Olsen (2003) adds that it includes fundamental goals, institutional processes, and structures that create the basis for planning and decision-making. In other words they are values and institutional arrangements (Olsen et al, 2006a) that influence: (a) the use of a resource or an environment, (b) problems and opportunities and their analysis and evaluation, (c) acceptable and forbidden behavior [in an environmental parameter], and (d) rules and sanctions, including their applications to guide natural resource allocation and use.

The foregoing is significant in weaving the discourse of marine environmental management in the context of capacity mobilization for ethical stewardship, especially in relations to near-shore and offshore oil and gas production, amidst the need for the sustainable use and conservation of marine ecosystem and ocean environment. About 40% of the world's population is concentrated in the 100-km-wide strip of coast along each continent (see Millennium Ecosystem Assessment, 2005a). In addition, some of the extraordinary productivity of many oceans and coastal environments, such as oil and natural gas, are the reasons for their unique importance. Other than oil and gas production, which is relatively new, and seafood production, other benefits such as those collectively called "ecosystem services" are derived from the ocean. Ecosystem services are the natural processes by which nature provides renewable resources, maintain biodiversity, and sustain human life (ibid). Often, anthropogenic activities in marine environment tend to disrupt these services, and by extension cause a dysfunctional environmental parameter laden with impacts and wastes resulting from these human-induced activities. Vitousek *et al*., (1997) and Lubchenco (1998) argue that the rates, magnitude, and diversity of these disruptions within the marine environment have increased substantially, even exponentially, over the last century. Here, the extractive industry, and more specifically, the oil and gas production sub-sector is a principal culprit due to its excessive pressure on natural resources, resulting in significant harm to marine ecosystems (Pew Oceans Commission, 2003; U.S. Commission on Ocean Policy, 2004; United Nations Environmental Program, 2006).

When these disruptions affect loss of genotypes, populations, and species, they diminish the ability of the ecosystem to function properly and optimally. At a global scale, 60% of global ecosystem services are degraded (see Millennium Ecosystem Assessment, 2005b). Often, grave decisions are made to convert species habits, without due regard to the concomitant trade-offs in ecosystem services and other potential impacts on communities that are dependent on these environments. The fall out of these occurrences is the universal clamor for a greater stewardship and governance of the environment, in the face of growing economic development and developmental projects, in view of increasing trends of growth in the developing world. For instance, in 2002, the United Nations (UN) World Summit on Sustainable Development in Johannesburg, South Africa (United Nations, 2002) called for the "use of diverse approaches and tools, including the ecosystems approach", which can be aptly deployed for marine environment management, in order to reduce risks and unwanted ends for efficient decision-making. But, this will require responsible and inclusive oversight systems hinged on awareness drawn from varying sources, including those created by evolutionary scientific and technological conclusions. To this end, it is instructive to delineate the boundaries of science and its role in decision making, because science should not dictate decisions, but inform them (see National Research Council, 2008). And this is often done when science is discovering the workings of the natural and social, systems, the changes within these systems, or when it adopts and considers options for alternative paths, which are components that also shape Environmental Assessment (EA)—an important tool for marine management in the context of offshore oil and gas production.

As has been the case with EAs, researchers are of the opinion that scientific information is generated from a nuanced process, often convoluted, and "can contain uncertainties that are difficult to convey to a nonethical audience" (ibid). This calls for a need for decision makers to constantly access scientific information, in the case of EAs, that is actually informed by science, and are coherent, and credible (see National Research Council, 2004). And this is in view of the fact that scientific evaluation is a function of sustained and long-term observations that underpins scientific advice on stewardship and management of marine environments (see National Research Council, 2008).

A sustainable marine environment management and stewardship could make use of a “predictable, accountable and governance system” (ibid). According to the Joint Group of Experts on Scientific Aspects of Marine Environmental Protection (1996) as referenced by the National Research Council, critical to this process is the “cycle of learning” derived from the awareness of sets of problems and opportunities to their analysis, formulation of plan of action, and implementation and evaluation of the plan with the full involvement of the public and stakeholders. It suffices to state, therefore, that the paths threaded to identify options, conflicting interests and values are mediated, and courses of actions negotiated, considering that they are as important as the application of scientific information (Walters, 1986), especially when antagonists hinge on scientific uncertainty to validate their counterpoints. The danger posed by these contestations are quite significant, as often, and in the presence of the weak governance system, its consequence is the prevalence of disruptive economic systems that pillages the environment, with cascades of associated irreversible impacts left behind. Therein lays the exigency for the global scientific and governance community to insist on sustainable approaches to marine environmental stewardship, in relation to offshore oil production, and their concerted application.

By all indications, offshore oil and gas operations have the potential to generate a variety of impacts on the environment depending on stage of the process, the size and complexity of the project, the nature and sensitivity of the surrounding environment and the effectiveness of planning, pollution prevention, mitigation and control techniques (E&P Forum/UNEP, 1997). In the offshore oil production, these impacts are atmospheric issues, such as gas flaring, purging and venting from the platforms; and aquatic issues related to the discharges, into the marine environment, of produced water, drilling fluids, cuttings and well-treated chemicals, including spills and leakages from under- water pipelines (ibid). Other issues are terrestrially-based, and they include concerns around physical disturbance as a result of construction etc. (ibid)

According to Sharp (1979), concern about the effects of petroleum in the coastal, continental shelf, and ocean ecosystems has resulted primarily from the highly visible effects of massive oil spills, resulting in intensive studies, since the *Torrey Canyon* and Santa Barbara spills in the late 1960s. Furthermore, ecological damage from spills is a direct function of the concentration and types of hydrocarbon and their duration of exposure in the marine environment (ibid). The severity of these spills are felt when they are confined to a limited ecosystem, and conditions promote the mixing of the spilled product into the water column and sediments (ibid). The National Academy of Sciences (1975), following a study, concludes that 0.33% of hydrocarbon found in the world's ocean are derived from normal marine production operations, while 0.66% is a function of oil spills associated with production operations. Similarly, 26.2 % of marine oil pollutants are generated by river run-off, 9.8% by natural seeps and 34.9% are caused by marine transportation, with the remaining 28.1 attributed to diverse sources (ibid). Historically, efforts have been sustained by regulators to significantly lessen the degree of spills occasioned by offshore oil drilling and production. For instance, regulators require that the hydrocarbon content of produced brines disposed into marine waters were kept at a monthly average of not more than 48mg/1 with a daily maximum of 72mg/1(ibid). Hence it is imperative to maintain consistent ecosystem sampling, more generally, rather than limiting the measurements to platform and control sites, for a more sustainable marine ecosystem stewardship regime in relations to offshore oil production. But this raises the question: what amounts to sustainable marine ecosystems management in the context of offshore oil and gas production? The single most dominant word here which requires evisceration for a clearer understanding is sustainability.

Stuart Kirsch (2010) writes that the term sustainability has its roots in the 1972 United Nations Conference on the Human Environment in Stockholm. The focus of this conference was to conceptualize how to “maintain the earth as a place suitable for human life, not only for now, but for future generations” (Ward and Dubos, 1972, as cited in Danielson 2002). The critical concern was anthropogenic influences of industrialization on the environment, exemplified by its associated externalities and pollution (Adam, 2001). In addition, the International Union for the

Conservation of Nature (IUCN) in its 1980 publication *"World Conservation Strategy"* linked sustainability to development by suggesting that for development to be sustainable, it must account for the social and ecological factors, as well as the economic ones; of the living and non-living resource base; and of the long term as well as the short-term advantages and disadvantages of alternative actions (IUCN, 1980). The most current of these global conventions, the Sustainable Development Goals of 2015 (UN, 2015), among other resolutions, request the conservation and sustainable use and management of oceans, seas, and freshwater resources, which should also imply the implementation of environmentally sound management of chemicals and all wastes throughout their life cycle.

However, available literature indicates that the notion of sustainable development has a common origin in the United Nations report, *Our Common Future*, and that it was subsequently introduced to a wider audience thereafter. Consequently, sustainable development was defined by this report, also universally recognized as the Brundtland Commission, as 'the development that meets the needs of the present without compromising the ability of the future generations to meet their own needs' (World Commission on the Environment and Development, 1987). This definition is an integration of a conservation-centered, human- centered and equity-centered approach to sustainability (Reed, 2002). Yet, at the Earth Summit of 1992, the UN Conference on Environment and Development in Rio de Janeiro promoted a "growth-centered" approach to development by jettisoning earlier concerns about equity (ibid). This new thinking privileged the preservation of biodiversity through the protection of small, relatively pristine sites as conservation areas (ibid). But, it was a trade-off that opened the world to virtually unrestricted development (Stuart Kirsch, 2009), which is very true of the off-shore oil and gas production, as Techera and Chandler (2015) estimates that there are over 7000 offshore oil and gas installations and platforms on the continental shelves of over 53 countries around the world.

The concept of sustainability appears convoluted and has been severally interpreted to support the preferences of competing interests, which informs the reason Ihlen (2009) suggests that it is not a normative concept. It is not surprising, therefore, that despite the volumes of literature on this topic, there remains a considerable misunderstanding and hesitancy to embrace sustainability, especially within the industry. Hilson and Murcks' six guides prescription, especially for the mining industry, (see David Laurence, 2011 as cited in Hilson and Murck, 2000), in addition to Robert Gibson's five pillars of sustainability approach (see Gibson, 2001), have not been persuasive, as it seems, to positively shift perceptions within the industry on the question of sustainability. To this end, it is imperative to note that hydrocarbon is a non-renewable resource, and its production is unsustainable. Therefore, sustainable development for this industry should also mean that all processes of oil and gas extraction must be conducted quite responsibly and safely, with minimal impact on the environment. This paper evaluates and compares the EA processes of the offshore oil and gas industry of Canada and Nigeria. Its core objective is to critique the offshore and near-shore oil production EA predictions of these countries and compare them to international best practices, in relation to impacts on large marine vertebrates. As a result, two offshore and near-shore EA reports from Canada and Nigeria (Terra Nova and Hebron projects of Newfoundland, Canada and the Diebu Creek and Jones Creek projects of Niger Delta, Nigeria) were sampled as representative case studies.

Offshore Oil Overview.

Fossil fuel use is on the increase following the rise of China and India as important industrializing nations. Consequently, the demand for petroleum oil has increased in the face of dwindling on-shore reserves across the globe. Oil exploration and production have therefore moved to remote areas of deep-seas offshore marine environments. The first company to find oil at 1000 feet in the deep sea was Shell, and it was in 1975 (Canvar, 2010). This finding signals the era of more discoveries even deeper. Harzl and Pickl (2012) estimated that in 1989, deep water oil production in the Gulf accounted for a paltry 4%. However, by 1999, this figure changed to 44%; and by 2004, it would have changed further to 65% (ibid). In the US, deepwater oil drilling leases increased to 1, 100 in 1997 from the 1994 figures of just 50 (Bourne, 2010). In addition, estimated 6% of entire oil production is conducted within deepwater wells of more than 5, 000 feet, and the number is expected to double in the future (Cavnar, 2010). It suffices to state that major technological advancements have been made in this sector where the ten largest discoveries in the last two years took place (Harzl and Pickl, 2012).

All stages of offshore oil and gas operations generate a variety of solid, liquid and gaseous wastes (Khan and Islam, 2006; Khan *et al.*, 2006), and these impacts have devastating effects on the marine environment and its ecosystem (Khan and Islam, 2008 as cited in Joint Group of Experts on the Scientific Aspects of Marine Environment Protection (GESAMP), 1993; Khan and Islam 2007; Khan *et al*., 2006). From all indications, impacts associated with offshore oil and gas development are different from onshore oil and gas activities and this manifest by the four phases of offshore oil and gas production (Khan and Islam, 2008). The phases are seismic exploration, exploratory drilling, and installation of structures, production, and decommissioning of the platforms (ibid). Each of these phases has associated wastes: drilling wastes, human-generated wastes, and other industrial wastes (ibid). Also worthy of attention are the accidental discharges in form of air emissions, oil spills, chemical spills and blowouts (ibid). Here, I briefly review four main sources of pollutants associated with offshore platforms.

Produced Water.

Produced water is the formation water mixed in with oil or gas (Bakke *et al.,* 2013). After separation from the oil, the oily water is usually discharged from a platform or is re-injected into the reservoir to maintain pressure and oil production (Holdway, 2002). Produced water composition "is complex with several thousand compounds that vary in concentration between wells and over the lifetime of a well." (Bakke, *et al.,* 2013) Hydrocarbon in formation-water (which forms the bulk of produced water) is a small part of the total organic composition and is "mostly limited to a maximum oil content of 40mg/1 or less." (as cited by Holdway, 2002 in Brendehaug, et al., 1992)

Dispersed oil, aromatic hydrocarbons and naturally radioactive material found in produced oil are considered pollutants and harmful to the marine environment (Bakke *et al*., 2013, see also below). Pollutants associated with produced water have been found to "settle out onto the bottom sediments, cause volatilization to the atmosphere, and are often dispersed by water currents." (ibid) Moreover, they are usually ingested and metabolized by both pelagic and benthic marine organisms (ibid).

Drilling Wastes.

Drill muds are used in exploratory drilling and in drilling oil and gas production. Drilling muds are slurry used for a variety of purposes (Ellis *et al.,* 2012). The composition of drilling fluids, within the muds, are proprietor information; but, the major components include hydrocarbons and barite (Bakke *et al.,* 2013; Ellis *et al.,* 2012). Drilling muds are discharged at sea; thus, the waste is both a particle and a hydrocarbon. It has been estimated that oil discharged on drilling cuttings was the greatest source of oil pollution in the North Sea from drilling operations which peaked in 1985 at 25, 880 tons (as cited by Holdway 2002 in Kingston, 1992). In the United States, these drilling muds are estimated to account for 2% of the total waste volume generated by offshore oil operations (as cited by Holdway, 2002 in Reis, 1992).

A study examining the impact of drilling waste effects (oil-based drilling mud) in eastern Canada on sea scallops (*Placopecten magellanicus*) found mortality associated with exposure (Holdway, 2002). Furthermore, among the surviving animals, reproduction and growth were suppressed. This research raised concerns in scientific community about the chronic impacts of "low toxicity" mineral oil-based drilling mud in the immediate vicinity of drilling platforms including mortality, growth and reproductive effects (as cited by Holdway, 2002 in Cranford and Gordon, 1991). Oil based muds were eventually regulated (see Morse *et al.*, 1986) and testing of drilling fluids and new additives is now a required practice in the United States, Canada, and Europe (see Jones and Leuterman, 1990).

Oil Spill

Oil spills and blowouts, may have a low probability of occurrence, possess a high risk to marine ecosystem (Fisheries and Oceans Canada, 2011). Spills and blowouts are accidents that are adjudged detrimental to the environment and may occur during the life of offshore oil and gas development (ibid). A blowout occurs when “operators of a drilling rig are unable to control the flow of oil and gas or other fluids from the well, and it is released into the underground formation, marine environment, and/or atmosphere.” (ibid) Oil spills are associated with exploration and transportation (shipping or pipelines) of the product (ibid). The increase in offshore oil exploration and production operations is expected to increase the risk of spills, due to the escalation of marine traffic associated with construction and supply operations (ibid), and increased use of sub-surface pipelines for oil and gas transportation, could rupture due to corrosion.

Chronic Oil Pollution.

In combination, produced water, drilling muds and small spills result in chronic oil pollution (O’Hara and Morandin, 2010; Fraser and Racine, 2016). The later is not subject to mitigations (ibid). Events associated with chronic oil pollution can be legal or illegal depending on the jurisdiction, and could be accidentally or intentionally induced (ibid). Hydrocarbons from theses discharges rise to the surface and concentrate, producing a thin visible sheen around offshore oil and gas operations (as cited by O'Hara and Morandin, 2010 in Erin and OCL, 2003; see also Fraser and Racine 2016). There is concern that the cumulative impacts from chronic oil pollution can be a major source of seabird mortality (Burger and Fry, 1993; Wiese and Ryan, 2003, Fraser and Racine, 2016).

Light Pollution.

According to statistics, there are over 7, 000 oil and gas platforms on the continental shelves of over 53 countries around the world, with many of them having existed for about 20 years (Techera and Chandler, 2015). Light pollution associated with platforms is a concern for seabirds (Wiese *et al*. 2001; Montevecchi 2006) and other nocturnal marine organisms (Rich and Longcore, 2006). The two sources of light pollution are gas flares and artificial lighting because of their ecological consequences (ibid). Researchers have concluded that the intense flares at offshore hydrocarbon platforms are undoubtedly the most lethal light there is (Terres, 1956; Bourne, 1979; Hope-Jones, 1980). These flares which "let off gas from drilled wells and can reach up to 40m (131ft) burn most intensely at the initial stages of drilling and when hydrocarbon cannot be offloaded at sea due to extreme sea conditions." (Burke *et al*., 2005) In addition to issues around flares, "hydrocarbon platforms are embedded with imposing novel artificial light sources." (Rich and Longcore 2006) The intensity and oceanographic novelty of these light sources could have cumulative effect on the attraction and mortality of seabirds, as has been the case at the shelf edge of the Grand Banks of eastern Canada (ibid).

Effects of Offshore oil and Gas on Turtles and Seabirds.

Large mega fauna usually die when exposed to oil particularly during oil spills (see Geraci and St.Aubin, 1987: see also Fraser, 2014). In this section, I briefly summarize knowledge pertaining to marine animals (whales, turtles, and birds) to assist with understanding of the EA predictions analyzed below. To this end, research on the effects of oil on marine animals has received increased impetus.

Marine Turtles and Cetaceans

According to Geraci and St. Aubin (1987), turtles, like many cetaceans lead more pelagic existence, which is the reason most mortalities within their taxon go unobserved. As a result, there are few reports of marine turtles encountering oil (Geraci and St. Aubin, 1978). Turtles can be exposed to hydrocarbons through ingestion oil and can be deterred from nesting if oil is present on their nesting beaches (ibid)

Shockwaves in water are generated throughout the various stages of offshore oil and gas development. They are often associated with seismic surveys conducted by means of high-intensity sound from air-guns and explosives (Geraci and St. Aubin, 1987, Fraser, 2014). Even in the process of decommissioning, at the end of the life of the oil platform, explosives are used for the removal of platform infrastructure (Viada *et al.,* 2008). Noise pollution can have a significant impact on sea turtles and marine mammals (Geraci and St. Aubin, 1985, Fraser, 2014).

Sea Birds

Seabirds are increasingly endangered, at a global scale, due to offshore oil and gas development (as cited by Ellis *et al.,* 2013 in Lewison *et al.*, 2005). As indicated earlier, impacts derived from offshore oil and gas development on seabirds ranges from the several forms of hydrocarbon pollution, which may result from routine operational discharges or accidents (Wiese et al., 2001), Oil pollution can also be the result of sabotage, which is regularly the case in Nigeria (see Nwilo and Badejo, 2005). The operational discharge of produced water into the marine environment is a major source of concern (as cited by Ellis *et al.*, 2013 in Fraser *et al.,* 2006; O'Hara and Morandin, 2010) due to the potentiality of produced water to affect the thermoregulatory capabilities of diving birds (see also Jenssen *et al.,* 1985; Wiese and Ryan, 2003). Data on the physiological effects of oil on seabirds is thorough and has been subject to continuous review in the scientific community (examples are GESAMP, 1977; Brown, 1982; Holmes and Cronshaw, 1977; Bourne, 1976, Leighton, 1993).

Environmental Assessment (EA) Predictions Methods.

Predictions involving consequences of projects are crucial components of Environment Impact Statements (EIS) as decision documents (Culhane *et al*, 1987, Glasson *et al*., 2013). In other words, predictions reinforce EIS's capacity and importance as an action-forcing document and confirm that agency officials have complied with statutory requirements, which facilitates consideration of impact proposals (Culhane *et al*, 1987). Prediction is an EA process that must include participants, perspectives, institutions, values, resources, and other factors to determine prediction enterprise and its contribution to decision-making (Pielke, Roger, and Contant, 2003). However, the word 'predict', in relation to EAs, means to foretell with precision of calculation, knowledge, or shrewd inferences from facts or experience (ibid). In contrast, forecast suggests that conjecture rather than real insight or knowledge is apt to be involved. Predictions, therefore, are informed by theories and methods from different sources of knowledge, and needs to be quantified to be considered ideal (ibid). This is to say that prediction methods are broadly classified and are not mutually exclusive (Glasson *et al*., 2013). While all the methods are partial in their coverage of impacts, some seek to be more holistic than others (ibid)

Quantification of impacts implies specifying the units of measurement in which change is denominated, the unit of analysis or population where change is measured, and the time period during which the change will occur (ibid). Quite often, predictions are mostly a function of conceptual models of the functionality of the universe, which ranges in complexity from the intuitive to the explicit assumptions regarding the nature of environmental processes (Munn, 1979). In several instances, a prediction consists of indicating the nature of degradation to expect, or a no change in the receiving environment or possible enhancement of environmental quality(ibid). But, in other instances, predictions come in form of qualitative ranking scales which embeds figures from 1 to 5, 10 or 100 (ibid)

The Leopold Assessment Matrix is used to express the magnitude and importance of impacts on ten-point ordinal scales, state-of-the-art assessment methods are also useful in computing impacts, by means of appropriate measurement units, such as Jackson turbidity units, decibels, dollars, and the Shannon species diversity index (Culhane *et al*, 1987). The Leopold Assessment Matrix requires the listing of project actions /activities be placed with the environmental characteristics and conditions of the project environment to form a matrix (ibid). In this way, a cause and effect relationship is established between the activities, the described environment and likely potential impacts (ibid). In the same token, the identified impacts are predicted by means of the Peterson Matrix Method (ibid). Using this method, impacts are evaluated subjectively on a magnitude scale, at the same time the quantitative evaluation output follows a Leopold interaction matrix to indicate activity—environment interaction and cause—effect relationship.

In EIS analyses, “errors become evident when actual properties of forecast in the study’s sample are contrasted with the ideal characteristics of EIS predictions, quantifications, and clear measurement units, explicit statements of impact significance and probability of occurrence.” (Culhane *et al*, 1987) In other words, the central issue in rationalist prediction is quantification, which has less than a quarter of the forecasts in the sample quantified (ibid). Similarly, the location and timing of the forecast impact are congruent to forecast quantification in theory (ibid). To this end, a quantified prediction should be clear about the location and timing of the change that will occur (ibid). Below, I provide a few examples of environmental parameters used to give further expression to EA prediction.

Network methodologies synergize impact causes and their consequences by identifying the interrelationship that exists between causal actions and the impacted environmental factors (Canter, 1996), including those representing secondary and tertiary effects. Network analyses are quite useful for determining anticipated impacts associated with potential projects and also in aiding the discussion of anticipated project impacts and communicating information about an environmental impact study to interested publics (ibid). Network’s primary limitation is that it generates minimal information on the technical aspects of impact prediction and the means for comparatively evaluating the impact of alternative (ibid). Furthermore, networks can become very visually complicated (ibid). Networks make use of tools such as sequence diagrams and directed diagrams (ibid).

Checklists as a prediction method consist of comprehensive lists of environmental effects and impact indicators designed to stimulate the analysts to think broadly about possible consequences of contemplated actions (Munn, 1975). Its limitation is that the analyst may be misled to ignore factors that are not in the list, which could result in poor data generation often referred to as tunnel vision (ibid)

Associated with these approaches is the use of the “significance of the impact being predicted. In EAs significance is used as weights in aggregating predicted values across different impacts, For sake of emphasis, “quantified predictions epitomize the essence of competent engineering and rational planning anchored on scientific method.” (ibid) Similarly, “it maintains a powerful normative, professional hold on technical people involved with assessment (ibid). Project impacts are typically distributed among four substantive categories of forecasts, namely: physiographic, biological, economic and social forecasts (ibid) While the physiographic category deals with nonhuman living natural phenomenon, the biological forecast dwells on the non-human living organisms and their habitats (ibid). In the same vein, economic and social forecasts account for business and other money transactions, including human and non-economic phenomena respectively (ibid).

Environmental baseline studies needs to be clearly defined and with objectives. Otherwise, too much information of less importance is acquired, according to Noble (2010). This is where a comprehensive baseline study is inefficient technique (ibid). Therefore it is most useful in the EA process to identify the valued ecosystem components (VECs) most likely to be affected (ibid). VECs are aspects of the environment considered to be of most important from scientific or public perspectives warranting detailed consideration in the impact assessment (ibid). The criteria for identifying VECs are usually a function of regulatory status, ecological importance, socio-economic importance, and conservation concern of the affected environmental parameter (ibid). Similarly, once a VEC is selected, it is important to identify its objective or indicator (ibid). This is because the objective and indicator “represents the specific parameters, guidelines, or standards that must be met.” (ibid) Often they are evaluated as carrying capacity or set limits of environmental change (ibid).

In regards to what constitutes prediction best practice, Noble (2010), suggests that identifying the potential changes in impact indicators of the environment receptors, especially during EA scoping process, is critical. This would require determining the baseline and its trends, predicting the future state in the absence of project development, which is the future baseline, and predicting the future state with project development (ibid). In addition, impact predictions should provide insight into the nature of impact (ibid). Such characteristics could be represented as adverse or additive (ibid). It should also indicate the magnitude and degree of reversibility of impact or the likelihood that the predicted impact will actually occur (ibid)

Comparing EA processes in Nigeria and Canada

EA Process in Canada.

In order to adequately regulate economic activities in the environment, the Canadian Environmental Assessment Act (CEAA), a modification of previous similar legislations, was introduced in 1992 via Bill C-78. CEAA 1992 was reviewed in 1999 and amended in 2003 (Noble, 2010), and further repealed and replaced in 2012 (CEAA, 2012). The overall goal of this legislation was to ensure that projects are carefully considered by federal authorities prior to execution; and that such projects do not pose considerable adverse effects. The federal CEAA applies to offshore projects (see Fraser and Ellis 2008). In summary, Canada's approach to EA administration appears subsumed in greater flexibility for all the affected parties, especially the proponents and assessment administrators (ibid). Canadian procedures allow for extensive public involvement in EIS review, which is usually an open planning process. The most significant advancement in Canadian EIA in recent years is the development of EA above the project-level—at the level of policies, plans, and programs (Noble, 2010).

EA Process in Nigeria.

In Nigeria, matters of minerals and petroleum resource regulation are centrally administered by the federal government. This is because the ownership and control of all minerals, mineral oil and natural gas in Nigeria are vested in the Federal Government (Owolabi *et al.,* 2014). This oversight authority of the federal government is exercised through the vehicles of (a) ministry of petroleum, (b) Department of Petroleum Resources (DPR) and Nigerian national Petroleum Corporation (NNPC) (ibid). It is the responsibility of the Ministry of Petroleum to formulate, implement and coordinate government policies for the industry (ibid). To this end, the Ministry co-opts the Department of Petroleum Resources (DPR) as a regulatory tool for exercising this function (ibid). Therefore, the DPR monitors the industry and supervises all licenses and leases in the country, in order to effect compliance and ensure adherence to applicable laws and best practices (ibid).

EIAs in Nigeria's oil and gas industry is conducted in line with the guidelines prescribed through EGASPIN (ibid). Consequently, the EIA process is designed to undergo seven stages of project proposal, screening, scoping, draft EIA report and review process, final EIA report, decision making, and finally, project implementation in that sequence (Ingelson and Nwapi, 2014). Although the department of Petroleum Resources is the agency in charge of the direct regulation of oil fields activities, EIA processes are supervised and approved at the level of the Ministry of Environment, in the event that the seven stages were successfully observed (ibid).

Methods

In this paper, I compare key predictions as they relate to marine vertebrates in two different systems: Newfoundland and Labrador, Canada offshore oil industry and Nigeria's Niger-Delta coastal offshore industry. The scope of this analysis is narrowed towards EA impact predictions on seabirds and marine turtles. The projects' EIS involves the Terra Nova and Hebron offshore oil and gas developments in the Newfoundland and Labrador of Canada and the Diebu Creek and Jones Creek near-shore oil and gas developments in the Niger-Delta area of Nigeria. I extracted predictions from each assessment and compared the predictions.

Case Studies.

Terra Nova and Hebron Oil and Gas Projects (Canada)

Both Terra Nova and Hebron Projects are oil extraction projects located in the northeastern Great Banks approximately 350 km Southeast of St. John's Newfoundland (See Petro-Canada, 1997; EMCP, 2011). Terra Nova oil field is estimated to harbor about 700 million barrels of crude oil (Government of Newfoundland), while Hebron oil field holds an estimated 566 million barrels of oil. The Terra Nova is a ship-FPSO, while the Hebron will be a gravity based structure. The major components of the project area ecosystem are plankton, mostly exploited by feeding seabirds, whales, and other predators; benthos, which include lobsters, shrimps, and crabs, which form important food source for many species of fish, including flatfish and cod; fish and marine-related birds and mammals (ibid).

In both EAs, seabirds and sea turtles were identified as VECs. In the Terra Nova, they divided up the predictions into "development Drilling and construction" and "Production." In Hebron EIS, predictions were provided under "Construction and Installation" and "Operations and Maintenance." Hebron considered changes in "Habitat quality, Habitat quantity, Habitat Use, and Potential Mortality (EMCP, 2011). There were predictions made for seabirds and sea turtles in both EISs (Table 1).

For both EAs, the potential effects were assessed with respect to magnitude of impact, scale of impact, duration and frequency, reversibility and ecological, social-cultural and economic context (Petro-Canada, 1997; EMCP, 2011). Terra Nova identified significance for each VEC, and almost all were most nonsignificant ratings (Table 1). In the same vein, significance for seabirds and sea turtles in Hebron was defined thus: "a significant adverse residual environmental effect is one that affects marine birds by causing a decline in abundance or change in distribution of population(s) over more than one generation within the Nearshore and/or Offshore Study Areas. Natural recruitment may not re-establish the populations (s) to its original level." (EMCP, 2011: 4-10) This definition was operationalized as *0= No detectable Adverse Effect, 1= Detectable Effect, No, Significance, 2 Detectable Effect, Significant; 3= Detectable Effect Unknown* (ibid).

Marine-Related Bird.

Marine-related birds prey on zooplanktons, benthos, and fish. It is estimated that over 60 species of birds were identified in the project study area, and millions of individual birds use the area annually (Petro Canada, 1997; EMCP, 2011). Amongst this 60 species, 18 of them are pelagic, 9 of which nests in the study area, just as a wide variety of water birds use the coastal and shore zones as well; and they include gulls, terns, cormorants, waterfowl, and shorebirds (ibid). Similarly, the Hebron EIS indicates that at the nearshore area of the project, Bald Eagles (*Haliaeetus leucocephalus*) nest in the Trinity Bay and may nest in trees near the shoreline of Bull Arm (EMCP, 2011). Other species known to occur in this area and in considerable numbers, especially in the winter months are Dovekie and Thicke-billed Murre (*Uria lomvia*) (ibid). The EA reports indicate that the effects of general operation of the project, in form of noise from seismic sound, oil spills, and accidental discharges, on-coming ocean vessel, helicopters and vessel lightings will be of no significance to the birds (EMCP Hebron, 2010). The Hebron EA predicted that these effects would be of negligible to low magnitude, up to 100 km^2 geographical , a frequency of less than 11 events/year, <1 month duration, and reversible (ibid). Furthermore, it was suggested that with the application of mitigation measures, the likelihood of effects occurring is low and not significant (ibid). Similarly, Terra Nova EA posted a non-significant rating for all the issues (Petro Canada, 1997)

Sea Turtles

There are three species of sea turtles that could potentially occur in the project area (EMCP Hebron, 2010). These species are Leatherback turtle (*Dermochelys coriacea*) enlisted as endangered, the loggerhead turtle (Caretta caretta), and the Kemp's Ridley turtle (*Lepidochelys kempi*). Leatherback and loggerhead sea turtles are regularly observed in this area of Newfoundland, especially in the summer and fall (ibid). The potential effect of the proposed operation of the Hebron project on sea turtles, which may be present in the project area, is that of sound pulses from the survey equipment (ibid). The EA report determined that the Jeanne d’Arc basin, including the project area, is not a breeding area for sea turtles, and thus, high concentrations of sea turtles are unlikely (EMCP Hebron, 2010). The effects on sea turtles were predicted to be negligible to low magnitude, up to 100 km^2 geographic extent, a frequency of less than 11 events/ year, < 11 month duration, and reversible. Mitigation measures, when applied, were expected to drastically reduce the likelihood of effects occurring to low or no significance status (ibid). See Tables 1(a, b) and 2 (a, b) for both Hebron and Terra Nova project EA predictions.

Table 1(a): Hebron Project EA Predictions on Seabirds and Turtles (EMCP Hebron, 2011).

EA Title	**EA Method**	**VECs**	**Hazards**	**Predictions**			
				Magnitude	**Scale of Impact**	**Duration/ Frequency**	**Significance**
Hebron Project	Screening	Seabirds	Construction & Installation	Negligible (1)	1	3/1 and 5/6	Insignificant Reversible
	Scoping. Boundaries.		Oil Sills	Negligible (1)	2	5/6	Insignificant Reversible
			Vessel Movement	Negligible (1)	2	3/6	Insignificant Reversible
			Lighting/Flares	Negligible (1)	2 and 1	3/6 and 5/6	Insignificant Reversible
	Comprehensive Study		Seismic sounds	Negligible (1)	2	2/1	Insignificant Reversible
		Turtle	Seismic Operation	Negligible (1)	2	2/`1	Insignificant Reversible
			Oil Spills	Negligible (1)	1/3	1/1	Insignificant Reversible

Table 1(b): Hebron Project EA Prediction Key (EMCP Hebron, 2011).

Magnitude	**Scale**	**Duration**	**Frequency**
1 = Low: <10 percent of the population or habitat in the Study Area will be affected 2 = Medium: 11 to 25 percent of the population or habitat in the Study Area will be affected 3 = High: >25 percent of the population or habitat in the Study Area will be affected	1 = <1 km2 2 = 1-10 km2 3 = 11-100 km2 4 = 101-1,000 km2 5 = 1,001-10,000 km2 6 = >10,000 km2	1 = < 1 month 2 = 1-12 months. 3 = 13-36 months 4 = 37-72 months 5 = >72 months	1 = <11 events/year 2 = 11-50 events/year 3 = 51-100 events/year 4 = 101-200 events/year 5 = >200 events/year 6 = continuous **Reversibility:** R = Reversible I = Irreversible

Table 2 (a): Terra Nova Project EA Predictions on Seabirds and Turtles (Petro-Canada, 1997).

EA Title	**EA Method**	**VECs**	**Hazards**	**Predictions**			
Terra Nova Project	Scoping	Seabirds		**Magnitude**	**Scale of Impact**	**Duration/ Frequency**	**Significance**
			Physical Structures	Negligible	Local	Not recorded	Insignificant
	Boundaries		Lights and beacons	Negligible	local	Not recorded	Insignificant
			Large oil Spill	Minor to Major	Sub-local	Short term to medium	Insignificant
			Small oil spills and discharges of other fluids	Minor	Sub-local	Short term to medium	Insignificant
	Level I & II Matrices		Effects of helicopters	Negligible, Minor	Sub-local	Short term	Insignificant
			Effects of ships and boats (Noise and vessel discharges)	Minor to moderate	Local	Medium term	Insignificant
			Effects of Vessels (Noise to birds)	Negligible, Minor	Sub-local	Short term	Insignificant
		Turtle	Not recorded	Not recorded	Not recorded	Not recorded	Not recorded

Table 2(b): Terra Nova Project EA Prediction Key (Petro-Canada, 1997).

Magnitude	Scale	Duration /Frequency
Major – 10% or greater impact on the carrying capacity of environment or VECs **Minor** –1 to 10% **Minor** –less than 1%. **Negligible**—Essentially of no effect.	Region—Impact affecting the Grand Banks area and adjacent nearshore areas, including onshore facilities. Local—within 1 to 10km from development activities. Sub-local—within 1km of development activities	Long term—lasts more than 5 years Medium term—lasts for 1 to 5years Short term –less than 1 year

Diebu Creek and Jones Creek Nearshore Oil Field (Nigeria).

The Diebu Creek project was managed by the Shell Petroleum Development Company (SPDC) of Nigeria Limited, and is located 5km east of the Diebu Creek Oil Mining Lease (OML) 32 field (SPDC, 2004a). The OML-32 field was situated within the longitudes 67500 – 70000N and latitudes 412500-415000E, which is in the southern Ijaw Municipality of Bayelsa State, approximately 100 km southwest of Port-Harcourt in the Niger Delta of Nigeria (ibid). The area is characterized by swampy and water-logged topography, including a network of creeks in a depressed plain (ibid).

The EA method adopted for this project was the simple matrix, and this is in tandem with the objective of ensuring a qualitative and quantitative description of all potential impacts associated with the proposed project activities (ibid). Similarly, The Jones Creek Oil Field was also a project undertaken by the SPDC of Nigeria, and was envisioned to boost the hydrocarbon reserve and hydrocarbon recovery in Jones Creek Field—SPDC's Oil Mining Lease (OML) 42 (SPDC, 2004b). Production at this site started in 1969 and peaked in 1972 with an output volume of 144mmbd/d (ibid).

In addition, 1989 marked the installation of four gas compressors with output of 18mmscf/d by the Nigerian Gas Company alongside the Jones Creek Oil Field (ibid). This project was located in the tidal brackish ecosystem located in the western part of the Niger Delta of Nigeria, which consists of numerous meandering creeks leading to mangrove swamps, freshwater vegetations well heads areas (ibid). This site "lies between Latitude 1180000N-190000N and Longitude 320000E – 335000E, bounded and drained by Nana Creek to the west, Escravos River to the south and Jones Creek to the north" (ibid). Both EIS were not specific in identifying VECs for impact analysis.

Jones Creek Oil Field EIA employed the Leopold Matrix Method to identify potential impacts (ibid). Some of the criteria employed in the evaluation of potential impacts include magnitude, prevalence, duration and frequency, adverse or beneficial etc. (ibid). Nonetheless, some of the issues identified for concerns and likely impact on wildlife and the environment were vessel movement, noise, and oil spill which received scant attention. The impact prediction rating for these identified issues was mostly negligible and nonsignificant (SPDC, 2004 a; SDPC, 2004b). See Table 3 for both Diebu Creek and Jones Creek EA predictions.

Table 3: Diebu and Jones Creeks Projects EA Predictions (SPDC, 2004a; SPDC, 204 b).

EA Title	**EA Method**	**VECs**	**Hazards**	**Predictions**			
Diebu Creek Project				**Magnitude**	**Scale of Impact**	**Duration/ Frequency**	**Significance**
	Simple Matrix	Wildlife	Flares				
			Noise (Construction)	moderate	Localized	Short term	Reversible
			Vessel Movement	moderate	Localized	Medium term	Reversible
			Oil Spills/ Accidental Spills	Moderate	Localized	Short term	Reversible
		Turtle	Not recorded	Not recorded	Not recorded	Not recorded	Not recorded
EA Title	**EA Method**	**VECs**	**Hazards**	**Predictions**			
Jones Creek Project	Leopold Matrix & Peterson Matrix	Wildlife		**Magnitude**	**Scale of Impact**	**Duration/ Frequency**	**Significance**
			Flare	Low/ adverse	Local	Not recorded	Insignificant Reversible
			Noise (flight of wildlife)	Adverse	Not recorded	Not recorded	Insignificant
		Turtle	Not recorded	Not recorded	Not recorded	Not recorded	Not recorded

Comparing and Critiquing Offshore Oil and Gas EA Predictions of Canada and Nigeria.

To adequately compare the similarities and differences between the EA administrations of Canada and Nigeria, in relations to offshore or nearshore oil and gas development, as demonstrated in their various EA prediction systems under study, the adoption of certain empirical criteria of evaluation and quality control becomes inevitable. This is in agreement with Ortolano (1993) and Sadler (1996) who pioneered the use of comparative studies, in the 1990s, to gauge the effectiveness and performance of EIA systems in the developed and developing world. In addition, some of these criteria of evaluation, found in the literature, which were characterized as systemic measures and foundation measures, were based on propositions by Wood (1995), Ortolano *et al*, (1987) and Leu *et al*. (1996, 1997).

The result is the propagation of such concept as "control mechanisms" which they described as "intraorganizational and intraorganizational and structures intended exact accountability and adequate stewardship in environmental impacts planning and administration (ibid). Consequently, nine quality control mechanisms were devised by Leu *et al* (1997); and they include legislative, procedural, evaluative, professional, public agency, administrative, judicial, follow up and international. These by implication informs the legislative and administrative procedures for such EA aspects as screening, scoping, report review, mitigation, and monitoring etc.

Systemic and Foundation Measures Comparison

The two jurisdictions under study (Canada and Nigeria) implement EA processes enabled by legislative provisions. These instruments are embodied by statutory frameworks of detailed laws and regulations, which vary according to jurisdictional and regional peculiarities. In addition, among other provisions, these laws are specific about timelines, in regards to decision making, throughout the processes. Similarly, there is a deliberate delineation of administrative roles of different agencies involved in the EA processes and regulations, and this has the potency to clog up the process due to red tapes, as is the case with Nigeria, where there is a tendency for functions to overlap among agencies.

Clearly, the EA processes in the two jurisdictions conform to practices commonly obtained in EA literature (see O'Hara, 2001), and which are adjudged universally as the norm for EA administration. However, the Canadian jurisdiction was more attuned to methods such as screening (see Wood, 2000), involving lists and thresholds, scoping, review and public participation etc. than the Nigerian equivalent as in most of Africa, which is devoid of reviews, monitoring, and public participation as parts of the process (see Kakonge, 1994). Nonetheless, it is instructive to highlight that EA for Offshore oil and gas projects is a mandatory exercise (see

Ntukekpo, 1996; Olagoke, 1996), according to the laws of these jurisdictions, although in Nigeria, the common thread is that projects are mostly often approved, with EAs consigned to being exercises of formality.

Finally, in relation to the foundation measures, the EA processes of both jurisdictions are subservient established guidelines required by the enabling EA legislations. They may not be implemented in practice, according to Fuller (1999) as is the case with Nigerian jurisdictions, due to professional and bureaucratic deficiencies; however, their effectiveness is a function of the quality of their content and other measures following their implementation such as effective monitoring (ibid). On this score, while Canada was rated highly, Nigeria's EA monitoring system was almost non-existent. Conclusively, on the weight of the information gathered on the EA practices of the two jurisdictions, it suffices to state that no particular EA system is superior to another, especially when they are all derived from the global norms of EA systems. However, when they are weighted against specific criteria, one becomes glaringly more advanced than the other. In this wise, it is important to indicate that the Canadian offshore oil and gas EA system holds far more superiority over the Nigerian equivalent on numerous counts.

Discussion

Predictions are paramount to EAs and are the very purpose of EA processes (see Noble, 2010; Canter, 1979)). Similarly, predictions of impacts of proposed developments, being the fundamental of EA processes, are varied in approach, in the same way each type of developments come with a suite of potential problems peculiar to that type of development, considering that development types are not same (Morris and Therivel, 1995). Consequently, in this trend are challenges to ecologists, as they are often unable to concretely determine ecological changes or losses in and around the development site, due mostly to inadequate data or poor understanding of the ecosystem (ibid)—a trend that is synonymous with the Nigerian system which is completely devoid of any baseline data. In addition, amidst a rapidly erratic political and legal framework, or where new discoveries in science and technology affect the form or operation of the site, impact predictions can be made difficult (ibid).

But, this is just one aspect of the conundrum, as predictions can be absolutely inaccurate, suggesting the presence of either system failure or the preference for economic considerations to conservation requirements by special interests. It is the reason Morris and Therivel (ibid) concludes that "all predictions are imprecise." For instance, they argued forcefully that the legislation that imposes the requirement to consider indirect and cumulative impacts expands the size of error even further, to the point that a few developers could become intolerable of the EA process altogether, especially in view of the increased expenses generated by what might be seen as a mere academic exercise (ibid). In Canada and Nigeria EA prediction processes, the evidence adduced by scholars seems to support this viewpoint.

According to Fraser and Ellis (2008), in the three offshore oil projects in Newfoundland and Labrador, the criteria used for a prediction to be significant was difficult to attain, thereby leading them to question the quality of the exercise. They also noted that sequential EAs were not linked: one the outcome of one project did not inform the prediction of the next one (see also Fraser and Russell, 2015). The predictions associated with light pollution in the Newfoundland and Labrador offshore oil projects are also problematic.

Incineration in platform flares and collisions with lighted structure also receive the same nonsignificant prediction ratings from these EAs (Petro-Canada, 1997, Fraser and Russell, 2015). Yet, available evidence in EA literature points to the fact that night-migrating birds are attracted to light sources in foggy conditions with the likelihood of causing their collision with structures or incineration by flares (Bourne, 1979). Burke et al (2005) questions the validity of these predictions, which are confused amidst dependence on inadequate baseline data on seasonal fluctuations of seabird densities and species compositions around offshore platforms. Furthermore, Burke *et al* (2012) argue that patterns of marine birds' attraction to flares and platforms, across species and seasons, are rarely quantified and information on mortality due to pollution, flaring, and collisions with lighted structure remain largely anecdotal rather than episodic events analysis. This invariably suffers the integrity of the predictions and their accuracy, in view of the various recorded evidence of birds dying after flying into flares on the Grand Bank (Wood, 1999). Attraction to oil platforms increases the likelihood of exposure to oil pollution (Fraser et al, 2006), another clear indictment on the prediction analysis, which overlooked this scientific reality. Predictions such as these require a threshold in which to gauge impact (see Fraser and Russell, 2015)

The purpose of noise prediction is to identify the short and long term of noise levels due to proposed developments and its significance, in relation to its interaction with environmental parameters within and around project area (Morris and Therivel, 1995). Noise prediction is a complicated process incorporating an expanse range of variables (ibid), which will affect the amount and type of sound originating from the project area and the response of the receiving environmental parameter. The Hebron EA (5.2.3: Marine Mammals and Sea Turtles), predicted the effects of seismic sound on sea turtles would be negligible to low magnitude, up to 10 km^2 geographic extent, a frequency of less than 11events a year, <1 month duration and reversible (EMCP, 2010), yet the capacity of the operators to collect such data is questionable. This is suggestive of the inadequacy of the EA analysis that led to non-significant prediction on sea turtles in the Newfoundland and Labrador offshore oil projects' EAs. In other words, there is the need for improvement on baseline data analysis and prediction processes in itself in order to arrive at more acceptable conclusions.

The Nigerian offshore oil development EA system, although heavily anchored on extensive regulations, policies and legislations, including globally acceptable EA principle, is light the actual EA implementation and administration. As an example, its prediction practices are not specific to the interaction of proposed projects' operations with environmental parameters, and this is even as VECs are not clearly identified for this exercise. Prediction efforts, therefore, are mostly functions of generalized observations and forecasts, a worsening trend that is attributable to the absence of baseline data that is needed for efficient EA analysis and predictions (Ingelson and Nwapi, 2014).

Another glaring hole in Nigeria's EA system is the absence of public participation as a fundamental element of the process, which removes the contribution of local people and integration of indigenous knowledge (ibid). Beyond the fact that the absence of public participation acutely affects prediction outcomes, the EA process in itself is iterative in nature, which implies that species at risk are merely identified, while existing gaps in the process impeded adequate assessment of the consequences projects developments on environmental parameters. In comparison with the Canadian EA system, which is robust and rigorous, the Nigerian equivalent is fraught with deficiencies and lacks the standard methodology for incorporating wildlife issues (ibid) amidst the plethora of oil spills and similar accidents that are the character of the Nigeria offshore or nearshore oil operations (see Nwilo and Badejo, 2005; Eregha and Irugbe, 2009; Emoyan *et al*, 2008 and Nliam, 2014).

Earlier in this paper, Pielke, Roger and Contant (2003) stated that EA prediction is a process that includes perspectives, institutions, values resources and other factors to determine prediction and, which in turn aids decision-making. Similarly, Noble (2010) averred that critical to prediction is the identification of potential changes to impact indicators of environmental receptors, the determination of initial baseline and the capacity to effectively provide insight on the adverse nature or otherwise of the predicted impact, the magnitude and reversibility of impact, including the likelihood that the predicted impact will occur. These are good grounds for assessing the EA prediction practices of both Canada and Nigeria in accordance with the best practices parameter. Although the Canadian offshore EA prediction practices still habour some degree of inefficiency, in comparison to its Nigerian equivalent, it largely conforms to the standard practice of EA predictions. In the same token, the single most critical issue affecting the quality of offshore EA predictions in Nigeria is the absence of baseline data, as we learnt earlier in this paper. Added to that is the removal of public participation and monitoring in the system, including the failure to identify and adopt VECs as key elements for prediction. The consequence, is that Nigeria’s prediction process is deeply flawed and lacking the requirements of best practices. There is the urgent necessity therefore for the Nigerian authorities and EA professionals to ensure and up-gradation of their EA system and practice in line with acceptable best practices.

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