

A Balance Sheet for Intergenerational Equity: Accounting for Sustainable Communities*

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Abstract

Gross Domestic Product is a touchstone for growth and prosperity. However, this calculative practice is now dissonant with current natural resource depletion and social strife. The institutionalized social practice of NEA on which GDP is based, privileges flows over stocks under the untenable assumption that the stocks to fuel the flows are infinite. Various models of Genuine Progress Indices have been developed to better proxy community wealth to improve policy-making. Although some models monetize many of the natural, social and economic indicators, the values are not recorded on a balance sheet. If the core of intergenerational equity is community-asset maintenance and the mainspring in accounting is assets, a balance sheet to monitor community wealth is obligatory. A pilot methodology and balance sheet are proposed, and valuation techniques are illustrated using the case of Cancún's marine parks, vital to the economic and social fabric of the surrounding community.

Keywords: sustainability; Intergenerational equity; balance sheet; assets; community wealth; Genuine Progress Index; NEA

A Balance Sheet for Intergenerational Equity: Accounting for

Sustainable Communities

"It is not that accounting serves the interests of the state. It is that the very notion of the state as we know it today is dependent on the elaboration of national accounting" (Miller, 1986: 101). Yet the "current national accounting system treats the earth as a business in liquidation"(Daly cited in Cobb et al., 1995: 66; Costanza et al., 2009: 9).

These two quotes summarize the role and responsibility of accounting particularly in the public sector. Governments employ, as well as deploy, accounting and statistics to create, develop, diminish, and even eliminate policies and programmes. National economic accounting (NEA), also known as Gross Domestic Product (GDP) accounting, measures the value of all output a nation produces over a year to determine economic prosperity and competitiveness (Moss, 2007). NEA reflects neo-classical economics focused on 'flows' rather than 'stocks' with the assumption that the ecosystem is infinite in its capacity to fuel economic growth. For example, a capital asset under standard accounting is assumed to deplete or depreciate unless restored or maintained. NEA does not incorporate asset depletion unless it gives rise ex-post to some economic flow to repair damage. The resulting GDP is the sum of all expenditures on final goods and services within a territory regardless of whether the transaction detracts from social wellbeing, such as clean-up costs of the Valdez oil spill, or an export depletes natural capital while consumed abroad such as Brazilian hardwood flooring in a Canadian household. Despite potential negative effects of this focus, the International Monetary Fund, the World Bank and national governments use changes in GDP as a criterion in policy and funding (Costanza et al., 2009; Daly, 1996).

Unlike standard accounting with centuries of history and development, GDP accounting and NEA came to prominence in the last 60 years since World War II. "National accounting was

from the start an accounting of national power, of its resources and objectives" (Miller, 1986: 83). From simple resource extraction to purchase more gold, economic strength shifted to the productive capacity of subjects in an age when England, France and the Netherlands were frequently at war (Miller, 1986). This shift was fuelled by new technologies such as 'political arithmetic' (i.e. statistics) and accounting methods. The First World War made governments visible as a source of demand and production but also as administrators of our resources (Miller, 1986). The uniform accounts and the Gross National Product (GNP) developed in the 1930s became a war planning tool in WWII. The accounts enabled nations to locate unused capacity, increase production (Cobb et al, 1995: 63), and highlight sectors for taxation to finance the war effort (Miller, 1986; Muller, 2003). With macro-economists stewarding policy, the economic model for financing the war was transformed into the model for peace and progress. Production (GNP) and then consumption (GDP) were lodestars of 'modernization', 'growth' and 'prosperity', concepts guiding reconstruction and to prevent another Great Depression. The success of GDP over the GNP¹ further distorted policies especially for countries heavily dependent on exports, the case of many emerging economies. As climate change and other environmental problems loom, there is increasing focus on sustainability. As such, new measures are needed that weigh the balance between economic activity, social wellbeing and environmental protection.

¹ While most nations have calculated a GDP since its introduction, only in 1991 did the USA switch from Gross National Product to GDP as a measure of economic growth (McCain, 2007). Policy analysts argue that GDP is more closely correlated with employment, productivity and fixed investment, and therefore a good short-term monitor. GNP is a measure of sources and uses of income, and a better measure of long-term investments (Moss, 2007).

I argue that the emphasis on 'flows' [production] over 'stocks' [assets] has led to unsustainable consumption, and propose a community balance sheet to redirect attention to the accounting fundamental of asset maintenance over the macroeconomic touchstone of unbridled production and consumption. Although the calculation of a 'community' balance sheet is difficult and debatable, the balance sheet serves to increase visibilities of the environment and the social; heighten awareness of the indelible interconnections between the environment, social and economic spheres; and clearly demonstrate how human activity whether helpful or harmful, ripples to all corners of our communities. Therefore, first is an overview of institutionalization and the practices of accounting, especially the importance of assets. This is followed by definitions of three asset accounts: natural, social-cultural and economic. Many current new measures have made important advances by proposing and/or testing both market and non-market valuation methods, indispensable for asset valuation. But few, if any, have produced a balance sheet that provides an overview of regional or sub-regional wealth and longitudinal changes in community equity. Using the case study of the marine parks adjoining Cancún, I propose a balance sheet to render visible the importance of Cancún's marine parks (CMP) to intergenerational equity.

1 Institutionalization of Social Practices

GDP is a product of macroeconomics which is an institutionalized social practice. An institutionalized social practice is a practice that is infused with value and embedded in networks of interdependence, thus constraining conduct and making it 'hostage to its own history' (Selznick, 1996: 271). More optimistically, institutionalized social practices empower as well as

constrain actors and define their available modes of action (Scott, 2001: 34). Other social practices include economics in general, accounting and statistics. All are forms of calculation and are based on specific conceptual categories. These social practices are reproduced through institutions that interweave, shaping the fabric of social and organisational relations (Miller, 1986).

The transformation of social and organisational relations, and institutional creation is a process of shifting political rationalities such as order, efficiency, modernization and now sustainability. The "impetus for institutional creation is the development, recognition, and naming of a recurrent problem to which no existing institution provides a satisfactory repertoire of responses" (Scott, 2001: 96). Once the recurrent problem is named, new concepts are debated by personalities that support or subvert the process. The concepts that are finally embraced form the basis for the development of additional theories and practices. The concepts, theories and practices are then supported by fresh institutional frameworks such as new associations and ministries that further develop practices and structures and purvey information to sustain the practices. Information improves decision-making and, iteratively, decisions are a function of the information available. "The availability of information thus, influences the attention structure of decision makers" (Scott, 2001: p. 169). NEA provides the numbers for the GDP which then drives public sector planning, policy and budgets.

Weick et al (2005) argue that sense-making results from disruptive ambiguity when "the current state of the world is perceived to be different from the expected state of the world" (Weick et al., 2005: 414). One example of information discordance with events and lived experiences is GDP increases while the general population experiences strife (Cobb et al, 1995).

The conclusion is that the GDP doesn't adequately measure what is important and valuable to communities. Sense-making follows dissonance wherein problems are "bracketed from an amorphous stream of experience and be labelled as relevant before ongoing action can be focused on them" (Weick, 2005: 415). Actions result in changes to legitimacy, to the substance of institutions and to the availability of information (Scott, 2001). The increasing discord between quality of life and the indicators that measure quality has lead many in the USA and in other countries to search for alternatives. In the face of the obvious social inequities and environmental degradation, sustainability emerged and was defined as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN WCED, 1987), now abridged to 'intergenerational equity'.

The concept of sustainability, like its predecessors progress and modernization, is ambiguous and subject to numerous interpretations. This ambiguity has lead to similar but competing definitions. Each definition gives rise to different technologies to proxy sustainability. For example, the Human Development Index (HDI), introduced by the United Nations Development Programme, is community-centred around the notion of human capabilities of which GDP per capita is but one element, the economic, of five basic freedoms for wellbeing. The HDI deducts, rather than adds, detrimental components such as the cost of crime and pollution (McGillivray & Shorrocks, 2005). Another example is the Genuine Progress Index or Indicator (GPI). The US GPI starts with aggregate personal consumption, rather than production, weighted by the Gini coefficient to adjust for income disparities. From this adjusted consumption value, components are added that reflect improved wellbeing such as household and community work. Then deductions are made for costs of defensive expenditures on health and education, and other costs

such as pollution, accidents and crime. (Cobb et al, 1995; Cobb et al, 1999; Natoli, 2008). GPI figures have been calculated for more than ten countries including United States, United Kingdom, Austria, Sweden, Germany, the Netherlands, Italy and Australia (Hamilton, 1999; Natoli, 2008). Sub-national GPIs have been calculated in at least five countries including Canada for the provinces of Alberta (Anielski, 2001) and Nova Scotia (PannoZZo & Colman, 2009a; PannoZZo et al., 2009b). As for developing countries, the GPI was calculated for Chile (Castañeda, 1999) and more recently Thailand (Clarke & Islam, 2005) and China (Wen et al., 2007). Not only do the results of the GPI confront the notion that growth and wellbeing are synonymous, but the increasing interest in the GPI demonstrates a broad-based movement towards more accurate measures.

One limitation of the new measures is that the data required to proxy for sustainability is limited to the information provided by the current social practice of 'growth' leading to the criticism that GPI measures are inaccurate due to excessive estimations and extrapolations (Neumayer, 2000). Another criticism regards the monetization of indicators, the ethical question of monetizing the invaluable. Monetization is not to compensate for the full extent of loss or gain in human terms but is a market-based proxy for far-reaching values (PannoZZo et al., 2009a: 29). Although both data and valuation are improving, the amounts continue to be listed or reported as adjustments to national income rather than recorded on a balance sheet. The absence of a balance sheet means that asset maintenance is obscured and important linkages between maintenance and depletion are not coupled. Subsequently, policy focus is still limited to bounded disciplines rather than remedial action based on broader outcomes.

1.1 Public Accounting and Assets

Accounting can be defined technically as the recording of economic transactions in monetary terms to provide stakeholders with the information needed for improved decision-making. Accountants allocate monetized transactions and events by sources (inputs) and uses (outputs) to track changes in stocks (assets) within an entity. Assets are things that are owned or controlled and have the possibility of providing future economic benefit (Potter, 1999). Assets are the mainspring of accounting (Boulding, 2008; Pallot, 1992; Storey, 2003). Liabilities can be regarded as negative assets (Boulding, 2008), revenue as a derivative of assets and equity is a claim on the assets (Parker, 1994). The claim on assets is intergenerational equity or future generations' net inheritance of long-term infrastructure, cultural capital and natural resources.

Assets minus liabilities equals capital, a claim on assets.² Claims on assets plus borrowing on those assets is referred to as the entity view of the organization because it represents an organization "whose management is [...] largely independent of the providers of funds" (Parker, 1994: 76). This is the case of elected governments that steward those assets for current and future generations. Governments control asset use with many policies encouraging borrowing on those assets to fuel GDP growth.

² "In economics, in contrast, and also in those areas of accounting strongly influenced by economics, "capital" is often used to signify not just capital claims (on the right-hand side of the equation) but also capital goods (on the left-hand side)" (Parker, 1994: 76). Accounting terminology is used here so the term 'assets' is preferred over capital.

Accounting attributes "financial values and rationales to wide range of social practices, thereby according them specific visibility, calculability and operational utility" (Miller, 1990: 316-317). These visibilities, calculations and utilities become objects of policy and regulation. Yet kept invisible under the current practices of Public Sector Accounting are our greatest assets.³ And these crucial assets are further distanced from visibility when public sector accounts nest into national accounts which aggregate government, corporate and household consumption. NEA is loosely based on standard accounting in that it employs double-entry to indicate the sources and uses of production. Also, NEA uses sector accounts to group entities and their transactions into a sequence of sub-accounts. However, here the similarity ends. NEA does not incorporate depletion, degradation or destruction of an asset unless it gives rise ex-post to some economic activity to repair or retard damage.

As a concession to sustainability, discussion nationally and internationally has turned to the introduction of accruals into PSA to monitor intergenerational equity. The essence of accruals is asset recognition (Potter, 1999). Despite the importance of assets, accruals will alter government accounts and encumber the relentless GDP race turning GDP winners into losers. In 2000, of the world's eight richest nations the average government expenditure as a percentage of GDP was 40.5% (Rosen, 2007: 9). More than two-fifths of these countries' output is consumed by the

³ The public sector is "that part of a nation's economic activity which is traditionally owned and controlled by government. That is to say, the public sector is composed of those public organizations which provide utilities and services to the community and which traditionally have been seen as essential to the fabric of our society" (Broadbent, 1992: 3).

public sector some of which is depletion and will reduce annual percentage growth under accrual accounting. And as nations differ in their techniques to collect and aggregate data, the System of National Accounts (SNA) proposes standardization to improve comparability of worldwide GDP further entrenching growth over sustainability.

1.2 Sustainability and Community Assets

New measures are being developed to better capture the human-ecosystem relationship. Hodge (1997) conducted a multi-disciplinary review of more than thirty conceptual models and found that the most common models recognized the need to balance the economic, social and environmental spheres. The economic sphere is generally a means of satisfying material needs such as food, clothing and shelter. Rather than simple final consumption, it is the production, and distribution as well as consumption of these goods and services (Herremans & Reid, 2002). The stocks and flows transacted in the marketplace are easily quantifiable in monetary terms. At the national level these activities are measured by GDP. This is the economic premise of wealth-maximizing, self-interested rational individuals acting under conditions of scarcity. This sphere is referred to varyingly as 'economic capital', 'man-made capital' or the broad nebulous term of 'human capital'. The term selected here is 'economic assets' (EA) to identify those assets that form part of economic activity.

The environmental sphere refers to the physical habitat and is often referred to as natural capital, here natural assets (NA) (e.g Hill in Hodge, 1997: 66-67). It is a "set of interacting physical components that can be identified and described in physical, chemical, and biological terms" (Hodge, 1997: 31). For some theorists, the environment is seen simply as an asset that

provides material, energy, and aesthetic resources to drive production and consumption activities of EA. Under such a view, the key is to manage resources and waste within a closed loop to ensure that the governing laws of thermodynamics are respected (Daly, 1996). For other theorists "flora and fauna might have value outside their abilities to satisfy the social and economic needs of individuals and societies" (Herremans et al., 2002: 18), in addition to fuelling production. The distinction between the two perspectives is whether the environment is considered to be at the service of humans or if it has intrinsic value beyond what humans value.

Therefore, there is a general agreement amongst different academics as to the definitions of environment and the economy (Herremans et al., 2002; Hodge, 1997; Sadler, 1990). Conversely, the components of 'social' are often referred to variably as cultural (Sadler, 1990), legal-administrative (Dorcey, 1991 in Hodge, 1997: 16-17) or political (CIDA, 1991 in Hodge, 1997: 20-21) in addition to the social. Within these compound conceptions, the social refers to health, education, community participation and gender equity, whereas cultural refers to value-systems and even spirituality. The one agreement about the social dimension is that the unit is groups or communities with shared values instead of wealth-maximizing individuals. For the purpose of this paper I employ the term social-cultural assets (SCA).

Once recognized and classified, the stewardship of the assets is facilitated through monetary signals. Although there is an ethical debate about monetizing the immaterial, Pannozzo & Colman (2009) argue that price signals are the most effective method to impact behaviour because "the policy arena is dominated by concerns over budgets, costs, and savings, and that expression of results in dollar terms reaches a much wider audience than expression in units specific to a particular indicator" (Pannozzo et al., 2009a: 18).

Equally important to signaling is the organization of the balance sheet. Assets should be nested in terms of longevity, from the fleeting EA on the bottom to more permanent SCA up to long-term NA. Borrowing on the assets are events, natural and human, that deplete the assets on which future generations depend for their economic benefit. Again, natural resource depletion means borrowing on natural assets. Human insecurity (financial, economic and physical) is a loan against SCA and EA. Intergenerational equity is the net claims on NA, SCA and EA pursuant to borrowing on those assets by the current generation. Following is the case study of the marine parks adjoining Cancún and a model balance sheet to increase visibilities of the importance of Cancún's marine parks (CMP) to local intergenerational equity.

2 Model for a Intergenerational Equity Balance Sheet

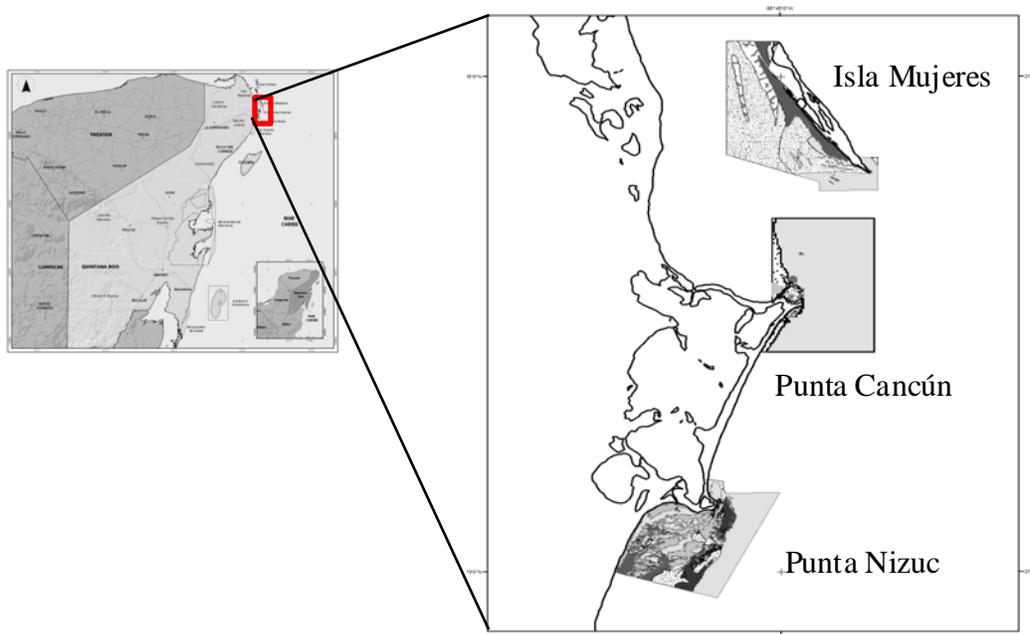
2.1 Case: The Value of Marine Parks to Cancún, Mexico

Cancún is the northern-most city of the eastern-most state of Quintana Roo (QR state) in México. From a population of 25,000 in 1975 and 300,000 in 1995, Cancún's population reached 526,701 habitants in 2005 (INEGI, 2006) and is estimated to exceed 700,000 by 2010⁴. Between 1995 and 2005, the population of neighbouring Isla Mujeres grew from 10,000 to 13,315 inhabitants.

⁴ The National Institute of Statistics and Geography (INEGI) is undertaking a census in 2010 with results to be released in 2011.

Despite the permanent resident growth which encourages economic diversification, Cancún remains almost exclusively dependent on tourism. Cancún has more than 139 hotels and 27,880 rooms of which 88 hotels and 25,283 rooms are in the Hotel Zone (91%) (Mora Flores & Moncada Jimenez, 2008). Cancún receives more than 3 million tourists annually up from 2 million tourists in 1995. Tourists spend an average US\$ 1000 per person per trip which translates into more than US\$ 3 billion annually up from US\$ 2 billion annually in 1995 (Mora Flores et al., 2008).

To maintain its allure, Cancún depends entirely on natural resources: sandy beaches, crystalline waters and water-related activities. For this reason, three reserves were established in July 1996: the west coast of Isla Mujeres, Punta Cancún and Punta Nizuc. The three 'polygons' form part of the system of Mesoamerican Reefs originating slightly north of Cancún in Cabo Catoche and extending more than 1000 km to the south through Belize, Guatemala and Honduras. The three polygons cover a total of 8673 hectares of coastal waters adjoining Isla Mujeres and Cancún. As such, they are referred to as 'urban marine parks' and in this study called collectively Cancún's Marine Parks (CMP).

Diagram 1: CANCUN'S MARINE PARKS

Tourism is a resource-based industry heavily dependent on eco-system services. Eroding beaches from unsustainable construction, increasing hurricanes, contaminated water and site overuse all deplete natural assets which devalues the destination. Devaluation leads to declining numbers of tourists, increased unemployment and hotel price-wars which reduce profitability handicapping hotel maintenance. Unemployment is correlated to increased crime and insecurity leading to more defensive expenditures on security systems and reducing disposable income for beneficial expenses such as education and housing.

The following is a proposed methodology for determining the value of healthy marine environments to the city of Cancun. I stress that the balance sheet does not fully represent the benefits provided by the three asset accounts of natural, social-cultural and economic. Nor does it represent all the possible costs of asset depletion. Instead the balance sheet is the 'canary in the coalmine', an early-warning system and a visual aid to problem areas. And monetization, rather

than valuating the invaluable, provides a common denominator for the components and as a shared signaling device between policymakers, stakeholders and the general public.

2.1.1 Marine Parks Balance Sheet

Although tourism is the mono-industry of the region and tourists come for the resources, those who actually profit from the resources are the residents who obtain employment and enjoyment from them. Since this is accounting of and for the community, it is the local residents and their wellbeing that are accounted for. To adhere to accounting conservatism, the study is limited to the direct beneficiaries of the parks: the hotels directly adjoining the three polygons, the tour operators who offer the park services to divers and snorkelers, and the Parks' Commission (*Comisión Nacional de Áreas Naturales Protegidas*), hereafter CONANP.

A first approximation of a balance sheet for intergenerational equity to determine the contribution of the CMP to the community via the economic activity of tourism is as follows:

Diagram 2: BALANCE SHEET FOR INTERGENERATIONAL EQUITY

2000-2005 COMMUNITY-FOCUSED BALANCE SHEET

ASSETS		in 2005 US\$	DEPLETION		in 2005 US\$
Natural Assets (NA)			Environmental Impact		
Beltweher Species	Reef Assoc. Species	\$ 43,365,000	Species Depletion	Invasive Species	\$ 849,954
Reef Services	Park Use	\$ 110,000,000	Reef Degradation	Reef Damage	\$ 1,323,000
	Coastal Protection	\$ 1,608,418,644		Ecological Footprint & GHG**	\$ 4,542,803
	Sand	\$ 220,000,000		Water Quality	\$ 325,000
TOTAL NA		\$ 1,981,783,644	TOTAL Environmental Impact		\$ 7,040,757
Social-Cultural Assets (SCA)			Living Standards and Insecurity		
Volunteerism - CMP**	Asset Maintenance	\$ 16,000	Financial Insecurity	Interest paid over 5 years	\$ 1,982,439
	Student Svcs (training)	\$ 8,000	Economic Insecurity	Household Head	\$ 1,031,184
	Research	\$ 2,500		Minors & Elders***	\$ 756,029
Education	CMP Employees & Chd	\$ 1,714,048		Health Problems	\$ 46,831
	Tour Operators & Chd	\$ 43,642,026	Physical Insecurity	Self-inflicted Violence	in process
Housing	CMP Employees	\$ 1,733,000		Interpersonal Violence	in process
	Tour Operators	\$ 30,800,000		Household Protection	\$ 2,277,551
TOTAL SCA		\$ 77,915,574	TOTAL Insecurity		\$ 3,816,484
Economic Assets (EA)			TOTAL DEPLETION		\$ 10,857,241
Parks' Commission**	Prop. Plant & Equip	\$ 462,000			
Tour Operators**	Prop. Plant & Equip	\$ 20,750,000	INTERGENERATIONAL EQUITY (Net Wealth)		
(- Adjoining Hotels)	above		Claims on Assets		\$ 2,070,053,978
TOTAL EA		\$ 21,212,000			
TOTAL ASSETS		\$ 2,080,911,218	FUNDING OF ECONOMIC PROGRESS*		\$ 2,080,911,218

** Still under review to refine the actual numbers
In the interim this is 2009-2010 estimate and min. wage

* a combination of claim on assets plus borrowing on assets
*** 2005 alone

Arguably the balance sheet is controversial and contains weaknesses. Nonetheless NA and SCA are more visible, interconnections between the environment, social and economic are made explicit, and policies can be assessed to determine the broader implications. Following is the method used to select each account and the valuation used for quantification and monetization.

2.1.1.1 Methodology

The recent field of environmental economics has refined methods, especially non-market assets, which allows for an approximation of intergenerational equity. Most important to this study are those based on observed behaviour in humans (WRI, 2009). These include economic impacts, replacement cost, travel cost method, total economic value, and damage and control assessment (PannoZZo et al., 2009a; Rudd et al., 2003; WRI, 2009) this last a form of cost-benefit analysis (Callan & Thomas, 2007; Kirkpatrick & Weiss, 1996; Smith, 1995). And relatively recent is the non-behavioural method called the habitat equivalency analysis to value marine damage and recovery (Milon & Dodge, 2001).

Diagram 3: SUMMARY OF PROXIES, METHODS AND DATA SOURCES

SUMMARY OF PROXIES, METHODS AND DATA SOURCES

ASSETS					
Natural Assets (NA)	Accounts	Justification	Proxy(s)	Method(s)	Data Source(s)
Bellwether Species	Reef Assoc. Species	Food; tourist attraction	High Trophic bellwether species abundance and density: sharks & rays, barracuda and grouper	US\$/tonne of sustainable reef fishing	Interviews; FishBase.org; Sea Around Us, 2010; Sumaila et al, 2007; SIIM, 2010
Reef Services	Park Use	Tourism & Recreation	# tourist-days annually attributable to parks	US\$ ave. daily total expend X #tourists X # room-nights (WRI, 2009)	CONANP Data; Cancun's Hotel Association
	Coastal Protection	Real Estate	Km of ocean-front real estate development protected by the reefs	US\$ construction per room X #hotel rooms	WRI, 2009; CONANP Map; Cancun Hotel Directory; FONATUR
	Sand	Tourism & Recreation	Beach nourishment	US\$ / km to replenish Cancun's beach following hurricanes	Welland, 2009; local media
Social-Cultural Assets (SCA)					
Volunteerism - CMP	Asset Maintenance	Community identity	# diver hours volunteered	US\$/specialist hour X # hours	CONANP information
	Student Svcs (training)	Training students; services to alleviate tight budgets	# student hours	US\$/generalist hour X # hours	CONANP information
	Research	Community identity; services to alleviate CMP budget	# reseacher hours	US\$ / hourly opportunity cost of specialist hour	Researcher information
Education	CMP Employees & Chd	Current wellbeing & long term investment	Total formal education cost of employee plus total cost of two children to similar educational level	Percentage of household expenditure + Per student non-current and recurrent govt expenditure (Genuine Savings)	Mexican Opinion Polls National Socio-Economic Levels 1995 to present; Secretaria de Educación Pública; Comisión Nacional de la Población
	Tour Operators & Chd	Same as above	Same as above	Same as above	Same as above
Housing	CMP Employees	Current wellbeing (health and security) & patrimony	Average house price	Sum of US\$ per ave. house per socio-economic level X # Wage-Earners per socio-economic level.	Mexican Opinion Polls National Socio-Economic Levels 1995 to present; Internet Real Estate websites
	Tour Operators	Same as above	Same as above	Same as above	Same as above
Economic Assets (EA)					
Parks' Commission	Prop. Plant & Equip	Current and future economic benefits	Undepreciated PPE	US\$ Value of equipment, boats and vehicles	CONANP inventory and information
Tour Operators (- Adjoining Hotels)	Prop. Plant & Equip above	Same as above	Same as above	Same as above	Same as above
DEPLETION					
Environmental					
Species Depletion	Invasive Species	Degradation of marine environment; indicators of climate change; Danger to tourists	Abundance and density of box jellyfish, starfish and lionfish	US\$ per kg to eradicate or fish X Av. Weight per fish X density per hectare	Interviews; FishBase.org; Sea Around Us, 2010; Sumaila et al, 2007; NSF, 2010; Sea Turtle Conservancy
Reef Degradation	Reef Damage	Reduction of reef protection; unattractive to tourists	HEA or estimated value based on reef protection	US\$ per m2 X m2 damaged	CONANP, 2010; Burke & Maidens, 2004; reefbase.org
	Ecological Footprint & GhG	Coral reef disintegration; water pollution	Costs of cleanup and reduction and/or replacement with biofuels	US\$ net benefits per kg of GhG reduction X kg/tourist X # tourists	Walker et al, 2001; Universidad del Caribe Tourism Bulletins
	Water Quality	Transparent marines for reef growth and tourism attraction. Also health concerns	Costs of cleanup, catchment, treatment and reduction	US\$ per m for catchment + connection to sewage system and installation of oil traps + institutional resources to monitor and sanction	CONANP 2010; Charles et al, 2002;
Living Standards and Insecurity					
Financial Insecurity	Interest paid over 5 years	Onerous debt levels and interest payments leading to economic instability	Percentage of monthly income for debt	Sum of US\$ per ave. house per socio-economic level X # Percentage debt per socio-economic level	Mexican Opinion Polls National Socio-Economic Levels 1995 to present;
Economic Insecurity	Household Head	Unemployment seasonal or permanent reducing household income	Productivity Loss	Inactive days X hourly wage X #%age workforce affected X #Workers	Instituto Nacional de Estadísticas y Geografía (INEGI)
	Minors & Elders	Additional stress on household economy	Increased number of dependents per household; uninsured for pensions and healthcare; teenage pregnancies	US\$ per person for food, clothing and housing per socio-econ level X increase in dependents per category	Universidad del Caribe Observatorio; Report Salud Quintana Roo
	Health	Stresses on household economy	Dengue from increased water levels; Obesity due to changes in diet and the lack of exercise	US\$ per person for treatment X % population affected X #workers + (Inactive days X hourly wage if household head)	Universidad del Caribe Observatorio; Report Salud Quintana Roo
Physical Insecurity	Interpersonal and self-directed violence	Increased defensive expenditures; reduction in disposable income; productivity loss	Direct cost of medical and non-medical + Indirect cost of lost productivity	US\$ per person for fatal, serious and slight injuries X %population affected X #workers + (Inactive days X hourly wage if household head)	WHO - Buchart, 2008; Universidad del Caribe Observatorio; Report Salud Quintana Roo
	Household Protection	Increased defensive expenditures; reduction in disposable income; productivity loss	The sum of household defensive expenditures 5 yrs	US\$ annual expense for protection X #workers	Universidad del Caribe Observatorio Survey on Violence

To select indicators and find data, I worked closely with biologists and sociologists. For example, to determine the bellwether marine animals, I worked with expert biologists in the area such as Martha Abundes from the Mexican College of Biologists, Jaime Gonzalez Cano, the Parks' Director, and Roberto Iglesias Prieto, Director of the Ocean Sciences Institute, Reef Systems, of the *Universidad Nacional Autonoma de México*, Mexico's most important national university. As for the sociologists and librarians, there was Jonaton Salazar at *Unversidad del Caribe Observatorio Local de la Ciudad de Cancún*, a UN -Habitat financed research center that has been collecting Cancún social indicators for more than five years. Last but not least was my research assistant Victor Cob, a tourism graduate, who ploughed through thousands of pages of *Instituto Nacional de Estadisticas y de Geografía* and other sources to find, organize and summarize the volumes of data.

2.1.2 Balance Sheet Accounts

2.1.2.1 Assets

For the CMP, NA include the marine life and reef services such as park use, coastal protection and sand production (please refer to Balance Sheet: Natural Assets). Conservation increases asset value through increased animal abundance and coral reef growth. Insufficient resources and/or authority leads to CMP depletion from overuse, pollution, accidents and natural catastrophes.

SCA are proxied by volunteerism, education and housing. To effect conservation, CONANP employs a staff of twenty including the CMP director. To supplement full-time staff, volunteers

include researchers conducting studies, university students completing practicums and divers assisting in special events. Volunteers and CONANP employees aside, an estimated 910 tour operator employees also depend on the park for employment. With steady employment long-term assets of permanent housing and formal education are assured (please refer to Balance Sheet: Social-Cultural Assets). Large SCA signal stable and secure communities while expenditures for debt, illness and crime signal decreasing SCA.

EA consists of the CMP plant and equipment to monitor and maintain the parks. Also, properly maintained property, plant and equipment of tour operators and hotels ensures a steady flow of clients (tourists). If tourist boats are maintained and upgraded greenhouse gas (GhG) emissions are reduced and less fossil fuel is spilled. If hotels are connected to sewage lines and install oil traps, Nichupté Lagoon is less contaminated. Following is a detailed proposal to quantify and monetize each of the accounts based on currently available valuation methods and data for the region.

2.1.2.1.1 Natural Assets

The marine environment is the area that has most suffered from the narrow focus of the GDP (Charles et al., 2002). Annual revenue from the fishing industry and park user fees is captured in GDP while ignoring the value of the fish remaining or a park that is healthy thanks to conservancy efforts. To value natural capital four dimensions have been selected: abundance of native high trophic level organisms, park use, coastal protection and sand production (CONANP, 2010a; Cooper et al., 2008; Rudd et al., 2003; WRI, 2009).

a) High trophic levels as bellwethers

Coral reefs are some of the most biodiverse and therefore complex natural areas in the world. An indicator of a healthy reef is the presence of high trophic level species because their absence or presence filters impacts lower level trophic organisms, they are easily recognizable by the general public, and have medium to high market-values (SIIM, 2010; Sumaila et al., 2007). Abundance and size also reflects preference for large piscivores by fishers but also for viewing by snorkelers and scuba divers (Rudd et al., 2003). The bellwether animals selected include shark & rays, groupers, and barracudas.

The benchmark mean trophic level is 3.25 (Sea Around Us, 2010). The Caribbean declined from that mean to currently 3.15 indicating 'fishing down the web', i.e. fishing lower-level species and smaller sizes. Balance requires the maintenance of trophic level species of 4.0 and higher (out of 5.0). The three bellwether groups fulfil this requirement, are of low resilience needing up to 14 years to double in population and considered highly vulnerable (Sea Around Us, 2010).

An example of their importance to reef health is the grouper. This species promotes reef growth by feeding on a small fish that eats adjoining coral to discourage competitors from moving in. Overfishing of grouper has seriously reduced their numbers such that two species, the Nassau and Warsaw groupers, are on the Endangered Species List. The longer a grouper lives in its lifespan of up to 40 years, the higher its reproduction. The loss of larger, more mature females has had disastrous effects on reproductive potential and therefore reefs (Coleman et al., 2000).

Ideally the normal density and age of the animals would be multiplied by the area to calculate 'healthy asset' numbers(Charles et al., 2002). Unfortunately, this information is unavailable. Alternately, one study found that sustainable artisanal reef fishing varies between 0.2 and 30 tons

per Km² with an annual average 5 tons per Km² (Jennings & Polunin, 1995). Reef fish are worth between US\$ 15,000 and US\$ 150,000 per Km² based on a market value of US\$1 to US\$ 15 per Kg (CONANP, 2010a: 153). With sustainable extraction of 5 tonnes per Km², a market value of \$75,000 per Km², an area of 8,673 hectares or 86.73 Km², the annual marketable value is US\$ 6.5 million annually (SIIM, 2010). As the bellwethers require a median of 10 years to double, their asset valuation is 10 years x US\$ 6.5 million or a total of \$65 million (please refer to Balance Sheet: Natural Assets - sub-account Bellwether Species). Otherwise said, if 7 tonnes per hectare per year are removed, conservatively 2 tonnes represent depletion of \$13.0 million annually.

b) Coral Reef Services to Humans

The second element is the valuation of the coral reefs themselves. "Coral reefs occupy less than one quarter of one percent of the Earth's marine environment, yet [...]are home to more than one quarter of all known marine fish species and tens of thousands of other species, many of which are found nowhere else on earth" (WRI, 2009: 2). In the CMP, the number of species found is: algae 187, sponges 47, soft coral 31, hard coral 33, black coral 3, mollusks 43, annelids (segmented worms) 65, crustaceans 37, equinoderms 24, fish 164, reptiles 6, birds 32 and mammals 11 (CONANP, 2010b).

Reefs, in addition to the important contribution to aesthetics and to recreation for snorkelers and divers, are fundamental to the production of sand and to mitigate damage to beaches and real estate during hurricanes and other storm systems (Cooper et al., 2008; Hoegh-Guldberg et al., 2007). The reef is an underwater mountain serving as a natural breakwater to buffer the nearby

beaches from the explosive energy injected into the water by the accelerating winds (WRI, 2009).

i) Park Use

The World Resources Institute (WRI) has developed a simple, reliable and low-cost method using data that exists in most countries (WRI, 2009). The method consists of the economic benefits for formal and informal fishers; the tourism benefits; and coastal protection. As fishing is prohibited in the CMP and I propose a calculation of the market value of bellwethers, this calculation is already addressed. As for the tourism benefits, the method is a simplified Travel Cost Method. It consists of assessing reef-related tourism based on how many tourists visit to use the reefs and the number of tourist-nights attributable to the day(s) spent in CMP. For example, scuba divers in Belize travel exclusively for the reefs therefore the full cost of their vacation is attributable to the reefs. In the case of Cancún, most tourists will spend one or two days of their vacation on reef-related activities and therefore the travel costs of accommodation, recreation, taxes & fees, and other expenses must be pro-rated.

The use of CMP requires the purchase of a US\$ 2 bracelet and CONANP collects statistics on the numbers of park visitors as well as boats with permits. For example, the number of users peaked in 2004 with 680,000 bracelets. Due to various crises, the average is down to 550,000 annually with 2/3 of the visitors in the polygon Punta Nizuc. With the average vacation in the region of five days and \$1000 per tourist per vacation, the amount attributable to the CMP is US\$ 200 per day x 550,000 visitors annually. In sum, conservatively the park use is estimated at US\$ 110 million annually (please refer to Balance Sheet: Natural Assets -sub-accounts Reef Services -Park Use).

ii) Coastal Protection

As for coastal protection against erosion and storm-system damage, again the WRI has developed a relatively simple calculation. First, identify land which is vulnerable. Next identify coastline that is protected by reefs or mangroves. Third, estimate shoreline stability and determine the shoreline stability attributable to the reefs and/or mangroves. Finally, estimate the damage avoided based on property values of those properties on vulnerable land protected by the reefs and mangroves (WRI, 2009).

Cancún and Isla Mujeres are high density resorts. From an inventory of only those hotels that directly adjoin the CMP, there are 2,055 rooms in the four-star category and 10,077 room in the five-star category. Isla Mujeres has a total of 1,318 rooms in three categories. In 2005 the estimation of hotel construction was per room \$150,000 for five-star, \$100,00 for four-star and \$50,000 for three-star. The 13,450 rooms adjoining the CMP have an estimated value of more than US\$ 1.6 billion (please refer to Balance Sheet: Natural Assets -sub-accounts Reef Services - Coastal Protection).

iii) Sand Production

Last but not least is the value of the sand and the replenishment called 'Beach Nourishment'. Each kilogram of sand requires 9-10 kilograms of coral (personal interview). The value of this sand can be determined because of the worldwide practice of 'nourishment'. Following Hurricane Wilma and the loss of huge tracts of beach, the Mexican federal government authorized the replacement with sand removed from beaches of Cozumel Island. The cost of an initial failed project was US\$19 million (Welland, 2009), approximately US\$ 2 million per kilometre for 10 kilometres. The subsequent 2009-2010 project cost US\$ 80 million for 10

kilometres with a total of 5.5 million m³ of sand (Martoccía, 2010). The adjoining parks cover 22 kilometres between Cancún (15 km) and Isla Mujeres (7 km) and beach nourishment costs US\$10 million/ km for a total US\$ 220 million.

Diagram 4: PHOTO OF CANCUN'S BEACH NOURISHMENT



2.1.2.1.2 Social-Cultural Assets

a) Volunteerism

Although unaccounted for in GDP, civic activity has a direct economic benefit and proxies for the strength of social networks. When voluntary work is withdrawn, activities often essential to wellbeing are reduced or eliminated due to a lack of resources. As volunteerism is unmeasured it is also insufficiently valued and given secondary priority in policy planning (Colman, 1998: 7).

Volunteerism differs from unpaid household work in that it is work performed outside the home. This form of unpaid work includes assisting charities called formal voluntary work, or assisting neighbours called informal voluntary work. Here the focus is the hours provided as

formal voluntary work to the parks to determine the unrecognised economic value that the park is receiving. In view of the current government budget crisis, volunteers from local universities trained tour operators in best practices, conducted research into park use and resources, and recently scuba divers helped to install the underwater museum. Over time the goal is to determine if volunteer hours increase (asset appreciation) or decrease (asset depletion) to indicate the strength of social networks.

Colman (1998: 17-20) suggests three monetary valuations: specialist replacement, generalist replacement and opportunity cost. Although accurate data on volunteers to CMP is being collected, as an estimate if 5 divers at US\$ 8 per hour provided 400 hours of voluntary services to place the underwater statues for the museum, five students US\$ 4 per hour provided 400 hours per student of practicum and five researchers US\$ 5 per hour volunteered 100 hours on research project, the total value is more than US\$ 26,000 per year (please refer to Balance Sheet: SCA - sub-account Volunteerism).

The exclusion of the economic value of voluntary work understates the important contribution economically and socially. Economically these services ease budgetary constraints. Socially, volunteerism proxies the underlying non-market value of strong community networks and identification with that community. Lastly, volunteerism is an indirect form of skills training by providing specialized knowledge of parks' management and research to volunteers.

b) Education

As mentioned in the previous section, park volunteerism is an economic benefit to the park as well as a provision of indirect skills training to the volunteers. Many organizations such as the OECD and the United Nations recognize that learning occurs in formal school settings as well as

settings outside the school and through media other than print. For these reasons, formal schooling, informal learning and competencies are needed to improve wellbeing. Competencies are those skills that add to literacy which improve employability and therefore living standards. These include science, ecology, health, nutrition and civic culture because "a basic knowledge of health is required to improve population health; political knowledge is required for effective civic engagement; and knowledge of sustainable living practices is required for ecosystem health" (PannoZZo et al., 2008: 1).

However, if countries such as Canada have a paucity of reliable data on key competencies and skills learned in formal and informal settings then there is little likelihood of such data existing for Mexico. Therefore, we are left with the traditional input measures of investment in property and equipment accounted for in national accounts plus current expenditures on teachers' salaries, books and materials, the method used by the World Bank to calculate Genuine Savings (Bolt et al., 2002). To this per capita amount is added household expenditure on education by the 930 households that depend on CMP for wages.

As there is no perfect measure, I look at household characteristics of employees and percentage of disposable income spent on education per income level. The Mexican Association of Opinion Polls (AMAI) produces an annual report on Mexican living conditions based on five socio-economic profiles (Lopez Romo, 2009b). The monthly salaries of CMP employees and tour operators operating in the CMP is superimposed over the profiles to produce an approximation of total costs, personal and public, to formally educate the employees and their family and household members(PannoZZo et al., 2008; SEP, 2010). The amount conservatively estimated is more than US\$ 45 million for the estimated 930 wage-earners and their children (see

Balance Sheet: SCA -sub-account Education and Appendix for calculation and refer to Methods summary for more information as to the precise calculation).

c) Housing

Taken for granted and undervalued is health and clean water. Thus, proper housing with access to municipal services is an indicator of healthy communities. Housing in Cancún has improved substantially. A 2000 report of 39 cities indicated Cancún as average to poor with 24% of the houses lacking concrete floors, solid walls or a permanent roof. In terms of size, Cancún's houses were amongst the smallest in the country with 64% of houses with two bedrooms or less while lodging six persons or more. And for basic services, Cancún was the third lowest with 43% of houses without water, drainage or electricity (Garcia Leon Loza, 2008). By 2005, solid buildings including concrete floor increased to 96%; the number of houses with more than three persons per bedroom had dropped from 27% to 12%; and houses with water, light and telephone increased from 33% to 75% (Observatorio Unicaribe, 2010).

Again using the AMAI socio-economic levels, that average house value is multiplied by the estimated home-owners within a given category. SCA asset value of home-owner housing is estimated at over US\$ 32.5 million for the 930 wage-earners. Housing, education and time available for volunteerism is a function of steady employment provided by assets of the CMP and the tour operators, the topic of the following.

2.1.2.1.3 Economic Assets

While the tourists are the visitors, the economic beneficiaries of the parks are those who obtain economic gain from the parks. Hotel property was recognized in NA under reef

protection so here I estimate the non-current assets of tour operators and park management, particularly property, plant and equipment (please refer to the Balance Sheet: Economic Assets).

a) Tour Operators

All operators that offer activities in the CMP require registration with CONANP and must purchase a park bracelet for each visitor. In Cancún there are a total of 35 operators and 22 more on nearby Isla Mujeres. Of the average 1800 visitors per day, the prominent activity in the polygons of Isla Mujeres and Punta Nizuc is snorkeling (76% and 87% respectively) whereas in Punta Cancún it is scuba diving (82%). Within the CMP scuba diving represents 8% of visitors, snorkeling occupies 77% of visitors, and boat tours the remainder. Annually there are 35,000 trips to Isla Mujeres with 20 passengers per trip for snorkeling and tours; 8,000 trips to PC with 7.5 passengers per trip mostly scuba diving; and more than 170,000 trips to Punta Nizuc mostly on jetskis to snorkel sites. The value of 60 catamarans, 15 dive boats and 190 jetskis is conservatively estimated at over US\$ 20 million.

b) CMP Administration

The average annual budget is US\$ 750,000 to regulate, train, study and report on the 8,673 hectares that make up the CMP. Of the twenty staff, nine are park guards, two are full-time environmental educators and the remainder is administrative and management. Park guards and monitoring use one-half the budget and the rest is for managing, training and reporting on the parks. The CMP also uses the services of CONANPs laboratory for coral seedlings which are seeded to existing coral heads and other structures to accelerate reef repair and growth. Although the parks have eleven boats on their books, only three are operational at any one time. In addition to the boats, equipment consists of office equipment and vehicles.

The CMP is currently undertaking a bold project located in Isla Mujeres of an underwater museum of 400 statues cast from living models. The goal is to shift use from reefs suffering damage to this new underwater gallery. The cost of this first project was US\$ 350,000 and required 400 volunteer hours to place the statues in addition to staff. This is an excellent example of asset investment to mitigate the liability of user and storm damage.

Diagram 5: CMP UNDERWATER MUSEUM: THE ART OF CONSERVATION



CMP total property, plant and equipment including the museum but excluding the coral laboratory is US\$ 462,000 to monitor park use and mitigate or repair damage, the topic of the next section on depletion.

2.1.2.2 Depletion

Part of the US\$ 2.1 billion in natural and social-cultural assets are being advanced through negative environmental impacts and human insecurity. Environmental liabilities include invasive species due to accidental introduction and species opportunism (warming waters); reef damage from vessel groundings and divers who accidentally hit or intentionally extract the coral; the production of Greenhouse Gases (GhG) and water pollution from fossil fuel and purposively

dumped waste waters that operators leave behind as well as the polluted water from the 4300 hectare Nichupté Lagoon that flows into the CMP, especially the polygon Punta Nizuc.

In terms of living standards, wellbeing is affected by insecurity: financial, economic and physical. Tourism is a seasonal and sensitive industry. An increase in crime rates (physical insecurity) can shift tourist preferences to other destinations causing unemployment (economic insecurity). Unemployment and an increase in household occupants reduce per capita disposable income and increases default on household debt (financial insecurity). In terms of the CMP, property-damage and the loss of beaches following Hurricane Wilma required more construction workers than bell-boys. Shifts in livelihood reasonably attributable to changes in the CMP attraction are recorded as depletion: real, contingent or footnoted depending on the circumstances.

Liabilities can be real or contingent. Under financial accounting rules, realized liabilities are always recorded whereas contingent liabilities are recorded if a future event is likely and the cost can be assessed. An example of recording a contingent liability is climate change which is scientifically proven and linked to GhG. Scientists offer scenarios of damage to NA under different assumption, for example reef system modelling based on a temperature increase of one degree Celsius, two degrees Celsius, and more (Hoegh-Guldberg et al., 2007). These effects should be quantified and recorded on the balance sheet based on conservative scenarios. The less conservative scenarios and their monetization form part of the footnotes. Conversely, Mexican reefs have suffered damage from vessel groundings. As the likelihood of a future occurrence or damage cannot be determined, the recording of such a liability is only reasonable ex-post.

A community is very complex so instead of attributing risk or damage directly through asset depreciation to arrive at net assets, depreciation is accounted for through increased depletion because of manifold impacts to NA, SCA and EA. For example, an increase of one to two degrees Celsius due to GhG emissions, causes coral bleaching and increases opportunistic species reducing beach protection and sand production. An increase in non-native jellyfish and lionfish leads to increased risk of stings to tourists that could reduce park visitors and lead to unemployment of tour operator staff with its resultant social impacts. Finally, recording of depletion separate from assets facilitates policy-making by highlighting the costs of poor decisions or inaction.

2.1.2.2.1 Environmental Impact

a) Overfishing and Invasive species

Three species that are threatening the reefs include the Asian lionfish, starfish and jellyfish. Jellyfish blooms are the result of warming waters which increase the abundance of their prey. Then there are jellyfish blooms caused by invasive non-native jellyfish that do not respond to the normal cycles and do not have predators. "Because jellyfish reproduce quickly, are hardy and face few competitors or predators in many degraded waters, they can quickly overrun and dominate ecosystems" (NSF, 2010). The presence of large blooms signals environmental problems favourable to jellyfish such as changes in temperature, salinity and oxygen concentrations. These blooms reduce tourism due to stings and affect industrial activity by blocking water intake valves such as desalination plants on cruise ships (NSF, 2010). The most venomous animal in the world is the box jellyfish now found in all tropical and subtropical

waters. Sea turtles are immune to the sting of the box jellyfish and regularly eat them keeping tropical beaches safe for humans (Sea Turtle Conservancy, 2010). Therefore, the decline in density of sea turtles could be inversely proportional to the increase in box jellyfish.

One of the most voracious species of starfish is parasitoid. It feeds on coral and will only die out once the reefs are devoured (IUCN, 2008). Their uncontrolled increase is due to overfishing and general ecosystem degradation. Yet the cost is low to prevent overfishing. Using ex-vessel prices for Caribbean medium and large fish, the average price is \$0.90/kg paid to artisanal fishers (Sumaila et al., 2007). Less than US\$ 1000 per tonne could compensate fishers to maintain extraction less than five tonnes per hectare annually (see above Natural Assets, Bellwether species).

The greatest risk currently to CMP is the non-native lionfish. In addition to uncontrolled consumption of native species, their spines are venomous and a danger to divers and snorkelers (Schofield, 2009). Lionfish were first reported in the nearby Cozumel Marine Park in 2009 and have now spread to all the Mexican Caribbean marine parks. Although in many areas they are being actively hunted and removed, the scientific community has labelled them as 'established' in Mexico and predicted invasion of reefs to the south in Belize, Honduras and South America (Schofield, 2009: 478).

Diagram 6: LIONFISH IN CARIBBEAN WATERS



In a recent study of the nearby Bahamas, the lionfish density per hectare was expected to be 80 but found to be over 400 per hectare (Green & Coté, 2009). At 400 per hectare and 2 kg per fish there would be a total of 70,000 kg of lionfish in 86.73 hectares of park. CONANP offered fishers MXP 150 (US\$ 12.25) per kilo to recover the fish or more than US\$ 850,000 (see Balance Sheet: Environmental Impact -subaccounts Species Depletion, Invasive Species). Although this is not the density of the lionfish, this amount proxies for invasive species in general until more accurate results are obtained.

b) Reef Damage

i) Users

In addition to CMP evidence of sites with the most reef damage, a recent doctoral dissertation (Santander Botello, 2009: 221-222) evidenced that divers had incidents of touching reefs or stirring sediment twice every five minutes on average. In Cozumel with deeper dives lasting approximately thirty minutes, this translated into total contact of twelve times per dive per diver (Santander Botello, 2009: 221-222). In CMP where dives average 60 -70 feet and last forty-five minutes, the same behaviour would result in eighteen contacts per dive per diver. In the first nine months of 2010, there were 67,000 divers in CMP. Assuming only one dive each, this number of divers translates into a total of 1.2 million incidents of contact or sediment-stirring in just nine months (CONANP, 2010b).

The new underwater museum mentioned above called 'The Art of Conservation', was inspired to shift users from damaged sites in order to allow for coral regeneration and coral seeding. Damaged sites require a minimum of three to five years to recover. The valuation per square

metre of the damage by divers is equivalent to that produced by vessels' grounding on reefs, the topic of a recent manual produced by CONANP (CONANP, 2010a) and addressed following.

ii) Vessel groundings

Of the 41 registered groundings in Mexico between 1997 and 2008, 24 occurred in QR damaging more than 13,000 m² or 46% of all damaged reefs in Mexico. If a series of events including groundings, overuse and storms, happens in rapid succession ecosystem recovery is severely handicapped (CONANP, 2010a). Once the damage has occurred, there are two options: natural recovery or active restoration. If left to natural recovery, algae recruitment is rapid while other marine species such as sponges appear after one to two years requiring up to a decade to return to normal levels. Stony corals take several decades and up to a century to fully re-establish (Jaap, 2000). Restoration by sinking cement blocks and coral re-seeding has a high success rate and significantly reduces recovery time (CONANP, 2010a; Jaap, 2000). To measure the viability of reef restoration and legal liability of vessels, the Habitat Equivalency Analysis was developed from wetland loss mitigation methods to quantify economic damages and restoration measures for injuries to coral reefs. Real costs of marine engineering for restoration plus subsequent monitoring constitute the costs to recover the damaged area.

For now a generic valuation based on economic activity is as follows. Reef value varies from US\$ 829 per Km² in areas where agriculture is the principal activity to US\$ 50,000 per Km² in densely populated areas that have lost their reef protection to US\$ 1 million per Km² to areas where tourism is the principal activity and beach maintenance is essential such as the case of Cancún (CONANP, 2010a). Burke and Maidens (2004) arrived at similar amounts for the Mesoamerican Reef System varying from US\$ 2000 to US\$ 1 million per Km² for highly

developed tourism sites. The preliminary calculation of park damage from hurricanes, swimmers, divers and groundings is estimated at 132 hectares (CONANP, 2010b) or $1.32 \text{ Km}^2 \times \text{US\$ } 1$ million as Cancún is high density or US\$ 1.32 million (see Balance Sheet: Environmental Impact -sub accounts Reef Degradation, Reef Damage). As this amount appears low, habitat equivalency analysis is necessary.

c) Ecological Footprint (EF) and Greenhouse Gas Emissions (GhG)

Ecological footprint (EF), simply put, is the "amount of biologically productive land and water area required to produce the resources an individual, population or activity consumes and to absorb the waste they generate, given prevailing technology and resource management" (Ewing B. et al., 2010: 100). Although EF is a more complete measure of biocapacity use and availability, EF is not monetized. GhG is a component of EF, the major contributing factor to climate change and GhG mitigation has been valued (Wilson et al., 2001). GhG damage reefs because the additional CO_2 mixes with the ocean's H_2O to form carbonic acid altering the pH level and dissolving the calcium carbonates needed for corals to produce their hard exteriors. Due to climate change reefs are disintegrating faster than expected (Hoegh-Guldberg et al., 2007). As CO_2 emissions make up one-half of Mexico's EF, the cost of GhG mitigation proxies for a portion of the EF.

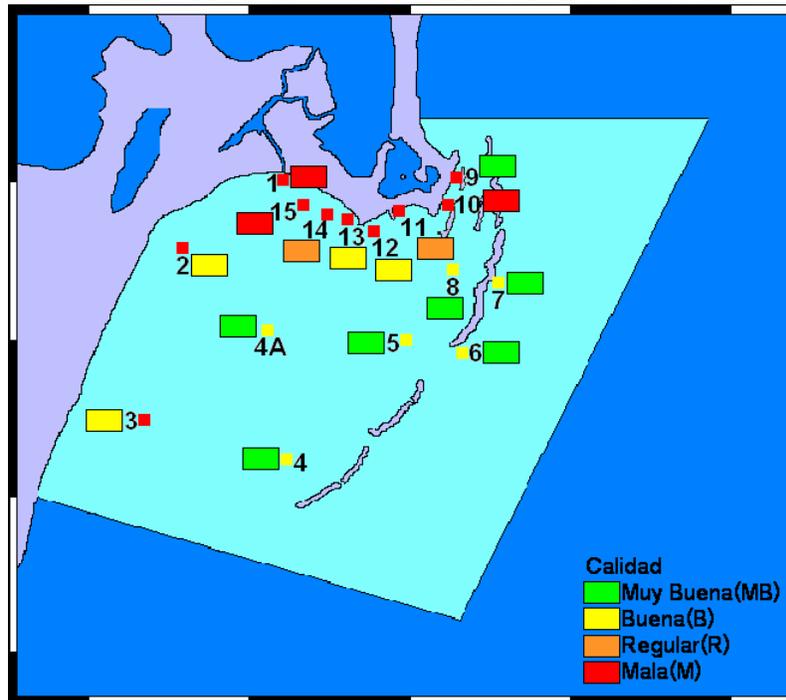
A recent study calculated that on average a tourist couple emits 106 -143 kg of GhG for a five day/five night vacation in Cancún. Of this amount, a snorkel tour on a boat with 10 people emits 3 kg per couple. Lodging plus breakfast emits 31 to 53 kg (Lopez Monzalvo, 2010). Attributing one day and night to the CMP plus the one day snorkel tour, emissions per tourist are approximately 13 to 16 kg of GhG. Net benefits per tonne of reduced emissions vary from \$50

per tonne to \$1100 per tonne depending on the method (Walker et al., 2001). One study calculated with fair accuracy the amount of US\$750 of net benefits per tonne of GhG reduction (Walker et al., 2001). As a first approximation, the annual liability to the CMP of GhG is 418,000 visitors in 2005 x 14.5 kg of GhG / tourist x savings US\$ 0.75/kg or US\$ 4.5 million annually. Admittedly this calculation requires refinement and confirmation using alternate methods.

d) Water Quality

For reefs to be healthy they need crystalline waters. Pollution increases sediment and climate change alters the marine pH level both of which affect water transparency leading to coral mortality (Burke & Sugg, 2006; Hoegh-Guldberg et al., 2007). Petroleum and non-petroleum oils pose risks to marine life through asphyxiation and tainting of all animals, from surface to benthic. Fossil fuels remain in the muscle mass of some fishes as carcinogens (EPA, 1976). For humans, fecal poliform bacteria in recreational waters is linked to increased risk of otorhinolaryngeal and intestinal infections, and in extreme cases typhoid (EPA, 1976).

In general, the water quality of the parks is considered good (Burke et al., 2006; CONANP, 2010b). The polygon at greatest risk is Punta Nizuc due to its proximity to the heavily contaminated 4,300 hectare Nichupté Lagoon. The pollution in the Lagoon includes fossil fuel from the numerous boats and marinas; oils, detergents and pesticides from adjoining hotels; and chemicals such as fertilizers from the two golf courses. Also parts of the Lagoon receive fecal matter from untreated waste water flowing from nearby hotels and buildings unconnected to the municipal sewer system.

Diagram 7: WATER POLLUTION IN THE POLYGON PUNTA NIZUC

The costs of water quality improvement are similar to GhG emissions: clean-up, catchment, treatment and reduction. The CMP procedure manual under review recommends three actions to improve water quality: the capture of rain-water run-off, the installation of oil traps and the connection of all buildings to the sewage system. Encircling the lagoon is the 50 km four-lane road where rain water collects pollutants from the road and chemicals from lawns and golf courses. As for oil traps, the report recommends the installation in all commercial centers, bars, restaurants and hotels on the perimeter. Lastly, is to ensure that all buildings on the perimeter are connected to the sewage system for treatment (CONANP, 2010b: 73). Cancún has sufficient water treatment plants but some adjoining older buildings are not connected to the network due to institutional insufficiency.

An important element in the calculation of depletion is insufficiency of institutional resources to enforce regulation. "Ideally, the indicator would measure total personnel and budget levels, relative to 'required' levels necessary to accomplish the goals of the fisheries management institution. However, it is unclear how to assess 'necessary' levels, except perhaps through valuation surveys" (Charles et al., 2002: 58). In other words, the incapacity equals the budget shortfall between optimal budgets to monitor and sanction, and actual budgets, for example, the cost to employ legal services to detect, negotiate, assist and/or sue building owners to redress regulation violations. To this is added the cost of financial or fiscal incentives to encourage building owners to install traps and connect to the waste-water network. The budget shortfall and incentives are under review.

In a study of costs to improve catchment, the cost of water interceptors such as drains, barriers and berms was approximately \$5/meter (Cox, 2004). If the lagoon perimeter with nearby buildings is 50 km or 50,000 meters, then an approximation of interceptors of one layer and only the perimeter is US\$ 250,000. As for monitoring, the initial investment was estimated to be US\$ 75,000 plus US\$ 10,000 of annual operating expenses. The amount calculated above of US\$325,000 in long-term assets is extremely low and severely underestimates the critical condition of the Nichupté Lagoon (see Balance Sheet: Environmental Impact -sub accounts Reef Degradation, Water Quality). In 2011, the municipal government is undertaking an inventory of marine life in the lagoon and the impacts due to the calamitous water quality which impacts the marine community and the wellbeing of the human community, the topic following.

2.1.2.2.2 Living Standards and Insecurity

The Millennium Ecosystem Assessment (www.maweb.org) used as a key component of the social all dimensions of security: financial, economic and physical. Financial security is threatened by debt levels and excessive interest payments (Hodge, 1997). Economic security is the condition of having stable income or other resources to support a standard of living now and in the foreseeable future. Indicators of insecurity include childhood poverty when caregivers' income is insufficient, an increase in persons over fifty with inadequate pensions and old-age security, and increased health problems. Physical security is the incidence of self-inflicted and interpersonal violence and is monetized by direct and indirect costs to prevent or repair injuries. As many entities measure changes in crime, poverty and elderly insecurity, it is possible to value and account for as depletion.

a) Financial Insecurity

Due to the high cost of borrowing in Mexico, excessive debt is a major burden on households and handicaps a company's ability to maintain and renew physical plant and equipment, pay salaries and even employ workers. Of the 930 estimated wage-earners who depend on the CMP for employment, 21 are estimated to be in the middle-upper income (C+), 74 in middle income (C), and 835 in lower income (D+). Surveys show that C+ spends 7% of monthly income on debt interest, C spends 5% and D+ spends 3%. Based on the medium income per group, the total interest paid by the 930 workers over five years is estimated to be over US\$ 2 million (Lopez Romo, 2009b). Notable is the fact that the proportion of interest has increased substantially in the past two years, e.g. C+ from 5.9% to now 7.3% of monthly income. Also

notable is that the increase in interest paid is at the expense of savings which dropped sharply over the same period (Lopez Romo, 2009a).

b) Economic Insecurity

i) Households and household head

Tourism is a volatile industry where hurricanes, pandemics and economic downturns in source countries have an immediate and devastating effect on visitors to Cancún and therefore employment. In addition to unforeseen events, there are the seasonal effects of low months of May and September when expensive equipment like catamarans are unused and seasonal employees laid off. In short, an increase in business uncertainty, seasonal and permanent unemployment, household dependents, debt and health issues reduces community wellbeing, often reflected in increased self-inflicted and interpersonal violence, as well as theft. These events are burdens on the household economy to secure property and persons.

Between high tourism season and low tourism season, unemployment increases by 1-1.5%. This results in 10 of the 930 workers being inactive for approximately six months of the year at an opportunity cost at QR state minimum wage (see above Volunteerism) or more than US\$ 200,000 in lost productivity annually.

ii) Minors and Elders

The stress of declining savings and increased borrowing is exacerbated by high numbers of non-working dependents (minors, unemployed and elderly). For example, between 2000 and 2002 the average number of inhabitants per household in Cancún jumped from 3.7-3.8 to 4.06-4.10. It had declined to approximately 3.9 by 2005 (Observatorio Unicaribe, 2010). However, the

number of elderly (60+) increased by 10%-12% in just five years. The use of doctors and hospitals jumped sharply from 5% to 10% of the population fifty years and older (CNEGSR, 2007). Also, QR has the highest level of teenage pregnancy in Mexico. The number of girls abandoning school more than tripled from 24,000 in 2000 to over 87,000 in 2005. Of all teenage girls in Mexico, pregnancy occurs in 1% of 12-15 year-olds; 10% of 16-17 year olds and 23% of 18-19 year-olds (CNEGSR, 2007). And only 60% of Cancún's population has health insurance.

Therefore, one estimation of health costs is the marginal household resources consumed that the increase in dependents. Of the monthly expenses, recurrent food, clothing and household services represent 59% for C+, 67% for C and 76% for D+. An increase of non-working dependents of 10% represented an additional household burden of over US\$ 750,000 in 2005 alone (see Balance Sheet Depletion -Economic Insecurity, Minors & Elders).

ii) Health

Although Mexico's medical infrastructure is improving with more medical professionals and better hospitals, changes in climate, age and diet will stress the health institutions. Climate change in warm, moist climates is expected to increase diseases spread by mosquitoes and other insects. These 'vector-borne' diseases include malaria, yellow fever, encephalitis and dengue fever. In QR state of increasing threat is dengue which per 100,000 was 300 regular and 70 hemorrhagic, the highest levels of dengue in the country in 2007. In a recent study of various countries, the average illness lasted 11.9 days for ambulatory patients and 11.0 days for hospitalized patients. Among hospitalized patients, students lost 5.6 days of school, whereas those working lost 9.9 work days per average dengue episode. Overall mean costs were US\$ 514 and US\$ 1,394 for an ambulatory and hospitalized case, respectively. If regular dengue can be

correlated to ambulatory and hemorrhagic to hospitalized, then the annual costs for the 930 workers and their family members is US\$ 50,000 over 5 years (Suaya et al., 2009).

Mexico is first worldwide for childhood obesity and second for adult obesity. Although QR state is low in childhood malnutrition, it has the highest levels in Mexico of childhood obesity. This information on the incidence and costs of obesity is being collected.

c) Physical Insecurity

Fatal and non-fatal injuries due to interpersonal (inflicted by another individual) and self-directed (inflicted upon oneself) violence result in large direct expenditures for the health care, law enforcement, criminal justice and welfare systems (Butchart et al., 2008).

i) Interpersonal Violence

In Cancún one in five persons has been a victim of some form of crime in their lifetime and in one in five households has been a victim of delinquency (ICESI, 2006). In the year 2005, 13% of Cancún's population over 17 years old was a victim of a crime. This translates into almost 500 crime victims between the employees and families of CMP. The most common crime is theft to the person while outside the home (44%) of which more than one-half is committed on public transportation. The other three most common crimes are home invasion (24%), sexual assault (11%) and aggression causing lesions (7%) (ICESI, 2006). Crime has increased in Cancún with homicides tripling to 4.3 per 100 000 in 2005. The majority of intrafamily violence is due to stress from unemployment and therefore peaks in tourism low seasons. The cost of these crimes is under investigation (Butchart et al., 2008).

ii) Self-inflicted Violence

The second cause of death in Cancun after accidents is now suicide. From 2004 when there were less than 24 suicides, by 2009 there were more than 120. And for every one that succeeds more than four did not. More than 85% of victims are between 15 and 34 years of age, and more than 70% are male. Using the latest WHO manual, we are currently calculating the economic cost of self-inflicted violence (Butchart et al., 2008).

iii) Household Protection

To protect persons and property, a recent study found that each household spends US\$ 500 per year on security measures (Observatorio Unicaribe, 2010) which translates into US\$ 465,000 annually or more that US\$ 2.25 million in five years for the 930 workers who depend on CMP. Although some of the amount is recurrent, much is non-current defensive expenditure for more bars, locks and private transportation.

2.1.2.3 Intergenerational Equity

The current estimated depletion of environmental impact of US\$ 7 million and of declining living standards of US\$ 5 million is a deduction from US\$2.1 billion of NA, SCA, and EA. Although equity is still over US\$2 billion and the amount appears small, it represents in this small-scale study 0.6% of assets. It is probable that a far greater asset depletion will result from a balance sheet every five years based on census collection.

One limitation of the new measures is that the data required to proxy for sustainability is limited to the information provided by the data collection for 'growth'. In other words, technologies have yet to be fully developed and standardized for new data to make visible and

manageable conditions for sustainability. However, current data limitations do not make the exercise redundant. A variety of valuation techniques enjoy increasing diffusion such that sustainability can be legitimately proxied through measures of NA, SCA and EA. For example, the balance sheet highlighted that the Mexican federal government spends \$19 million on beach 'nourishment' or 1% of NA while CONANP receives less than 0.04% of the reefs' value (US\$ 0.75 million) for its annual operating budget to monitor reefs that provide more than \$2 billion in services to hotels and tour operators. While tourist revenues climb to US\$ 3 billion annually homicides tripled in five years, suicides are a daily occurrence and CMP employees invest US\$ 500,000 to protect their properties and persons. These numbers reflect some of the policy imbalances in the absence of a balance sheet. A balance sheet is key to unravel some of the unintended consequences of budget allocations narrowly focused on 'growth'.

3 Conclusion

Practices such as accounting, rather than simple techniques, are technologies because the series of procedures and rules that are adopted have the capacity to transform (Miller, 1986). Data is collected based on what is to be made visible and managed as a function of the concepts embraced. Knowledge is thus constructed and codified which informs and constrains behaviour. "The construction of social reality is seen as ongoing continuously but also as providing models, schemas, and scripts to orient and guide current decision making" (Scott, 2001: 68).

The intergenerational-equity balance sheet is a step towards providing a more inclusive measure of the overall economy, one that renders visible resource stewardship and the activities which enhance or detract from wellbeing. Although not a perfect measure, the balance sheet is

meant to spur debate about policy directions and resource allocation. The measurement of environmental depletion is particularly urgent for Less Developed Countries because of the strong links between the environment and poverty (Castañeda, 1998) and because of a dependence on natural assets for wealth and exports both primary products and tertiary services such as tourism in Cancún. Depletion is underestimated because erosion and biodiversity loss is unaccounted for, and the community benefits from protecting and investing in NA are obscured. The top twenty-five nations ranked according to the contribution of tourism to GDP are island destinations. Development strategies based on raising the GDP undermines the environment and the household economy diminishing the wellbeing of the nation's people while devastating the habitat (Cobb et al, 1995).

This balance sheet which was based on 2005 data should be calculated for 1995, 2000 and 2010. Arguably the reference balance sheet should be 1995 in constant US dollars with adjustments to 2000, 2005 and 2010. This more accurately indicates the full borrowing on assets over the past fifteen years and the specific areas that need attention such as marine pollution, public security and credit card debt. Other future research includes a study in similar coastal tourism sites to corroborate the selection of accounts and proxies. To improve policy decisions, once balance sheets are calculated, state and local financing through taxation could be compared to the balance sheet results to illustrate adjustments to current budget allocations.

The importance of assets to ensure sustainability has been recognized but is not operationalized. The lack of operationalization is demonstrated by the absence of efforts to develop a balance sheet which can be used by policymakers to prevent disasters and degradation rather than simply reacting to them. Although all formulations of the GPI and this balance sheet

are subject to criticism of items included or excluded and valuation techniques, the debate over inclusion or exclusion of variables and valuation methods is common to all selected measures from public sector accrual accounting (OECD, 2000) to the System of National Accounts (SNA 2008, 2009) to the genuine progress indices (Neumayer, 2000). Micro-economics, especially environmental economics, have made important advances in valuation methods over the past decade. These methods combined with balance sheet accounts shifts focus to activities and outputs that privilege human development and environmental protection over a narrower focus on economic production and myopic growth. No enterprise operates effectively and survives over time without a balance sheet. Since we cannot manage what we do not measure, a balance sheet serves to increase visibilities of environmental and social assets; heighten awareness of the indelible interconnections between humans and the ecosystem, and clearly demonstrate how events in distant sites like the CMP positively or negatively impacts a broader community.

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