VAPOR BC
6911 Dusnany Place, Richmond, BC, V7C 4N8
Phone: 604 274 7655
www.vaporbc.com <vaporgroup1@gmail.com>

VAPOR Presentation to the CEAA Panel on Roberts Bank Terminal 2 Environmental Impact Review. by Otto Langer May 24, 2019.

What is an Estuary Worth? Are Globally Significant Populations of Salmon and Bird Life Not Worth Protecting?

1. Introduction: The bigger picture and non-sustainable growth.

The above titled questions are not meant to be cute. Considering where the Fraser Estuary now sits in terms of its present industrialization and never ending industrial and population growth, it is our concern that should RBT2 goes ahead the estuary will be reaching a phase much closer to its ecological death.

Many Canadians may be smug because this is Canada and we are led to believe we are supposedly a green country. However, many of our natural settings in Canada (rivers, estuaries, lakes, oceans, terrestrial habitats, fisheries, bird populations and our air) are in dire straits. This can be seen in the decreases and endangerment of our cod stocks, salmon, sturgeon, eulachons, southern Orcas, most bird species and in global warming and polluted waterways e.g. Great Lakes.

The United Nations just released the ***S. Diaz and R. Watson report on global biodiversity loss (Global Assessment Report Produced by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services(IPBES). May 2019. Bonn, Germany)*** - attached.

A million species of life are about to go extinct if action is not taken immediately to reverse that trend. Also the climate committee (IPCC) of the UN released a similar warning for climate change being irreversible if the alarming warming trend is not arrested within 10 years.

These warnings are the most convincing recent arguments against locating yet another large industrial project in the middle of one of the world's significant estuaries in the delta of a globally important river. If this is not understood the RBT2 Panel will have glossed over the global issues which directly bear on this estuary in this project review. The Fraser River and its estuarine habitats and fish, wildlife and plant life are undergoing the same impacts and losses as described by these UN reports. In that the Diaz – Watson report must be compulsory reading for the Panel and its staff, the press summary of that report is attached at the end of this brief.

The Fraser Estuary's fate is no different than that of Lake Ontario, the Mississippi Delta, and the status of local Orcas, the demise of our woodland caribou or the disappearance of the Amazon rain

NOTE: The port names have changed constantly in the past decades. This brief will refer to National Port Authority, Metro Port Vancouver, Port Vancouver, Vancouver Fraser Port Authority and its past river entities - the North Fraser and the Fraser River Harbour Commissions as 'the Port'.

forests. Due to unrelenting development pressures they are all suffering a relatively rapid march to an ecological death.

2. Key Ecologic Values and Habitats Threatened by RBT2.

a. The critical biofilm issue.

In the past it was known that the surface and near surface of a mudflat or sandflat did harbour a rich flora and fauna. It was known as epifauna, infauna, meiofauna, etc. In the past decade it was discovered that such a rich soupy film on part of the Roberts Bank area was a key food for such animals as the western sand piper. No one will dispute the need to protect such biofilm habitat but it cannot be protected as a habitat type unto itself. It is part of the overall production of that ecosystem area.

We are advised that the entire RBT2 project was located to protect this biofilm and associated mudflat area. That level of concern for biofilm is warranted but it is just one aspect of what has to be protected – albeit a critical one.

b. Loss of aquatic living space.

DFO was rather casual when they advised the Port that the real sensitive habitat area is to the east of the existing port area and thereby encouraged the port to move out into deeper water. This may have been akin to allowing the leg to be cut off instead of part of the heart of the animal. They are both essential appendages for a living animal.

It is ecologically unwise to play the game of just saving what is best and allowing the lessor valued habitat next door be sacrificed or compromised – usually to keep the proponent and the politicians happy i.e. a compromise has been found. To date the estuary has been compromised to a near death stage and only remnant parts of many habitat types are still surviving.

If ecological integrity of Roberts Bank and the estuary is important one cannot locate the RBT2 on the bank (mudflat) edge in subtidal waters and believe the impacts have been mitigated to such a degree that a bit of marsh habitat replacement elsewhere will balance out the equation of losses and gains. An isolated habitat type whether a biofilm area, a mudflat, marsh or riparian area cannot survive or not function as a meaningful part of that local ecosystem.

Most non-sessile fish species migrate in and out and across the estuary. A closer look at two salmonid species (chum and Chinook juvenile salmon) will of course do this and they take advantage of the invertebrates produced in the riparian vegetation, marshes, and flats. To do that they have to move in and out twice a day with the tides. When the tides are low these fish have no place to go other than into the waters at the bank face (i.e. the area where RBT2 is planned). Here the fish will rear, continue to feed and take advantage of the next flood tidal cycle.

The original Roberts B**ank Port and now** RBT2 are positioned to fill in this habitat area and deprive the crab, and fish like chum and Chinook that living space. Some will say they have the whole ocean for living space but that is a false when it comes to certain life cycle needs for each species.

The RBT2 site occupies about 18 percent of the Roberts Bank face. Once the old port is added that is double that amount. In terms of the entire estuary bank face from the North Arm to the BC Ferry Terminal RBT2 will take up about six percent of the bank frontage. This is a significant consideration and impact and that impact does not take into account the actual loss of living space covered and filled in by the large amount of fill for the two ports and the causeways.

In addition to the blockage of the bank front, the actual fill area is massive and eliminates the bottom production in that area and volume wise removes a great deal of living space from the estuary. As noted above this interface subtidal area between the mudflats and open marine waters is an important habitat area to various fish species and diving birds.

c. Jetties, causeways, and barriers.

The port and its causeways do serve as a barrier for fish movement. This impact was ignored for the original port and it appears to be ignored again and greatly exacerbates the impacts of the physical presence of this fill and causeway complex.

The above discussion does not take into account the impact of the many jetties and causeways that interferes with estuary water, sediment and plankton and fish movements. The Port would make one believe that putting culverts in their old causeway (due to be greatly widened) will accomplish little and could cause a mudflat scour problem.

In addition to this old port causeway a new one will be built to RBT2 and with that port fill create a giant causeway out into the estuary. The lower river and the estuary isnow home to many jetties and causeways. These causeways are also complimented in their negative impacts by river training walls built to narrow the river and enhance deep sea shipping. Present obvious Lower Fraser and estuary jetties, causeways, and training include:

- FC Ferries Causeway (total barrier)
- Roberts Bank port original causeway as widened and now to be extended by RBT2 (total barrier).
- South Arm south bank jetty (riprap and pilings)
- South Arm Steveston Jetty (rip rap and partly solid barrier)
- Steveston Channel training wall (piling and solid barriers)
- YVR old runway lighting causeway (solid barrier).
- YVR new runway jetty (pilings)

- Iona STP causeway (solid barrier)
- North Arm jetty (solid barrier)
- New Westminster, Annacis Island and Surrey Fraser docks (mainly solid barriers).

Has any effort been made to better understand how these barriers affect fish and estuary functioning and above all what are their cumulative impacts*? **Dr. Marvin Rosenau (Fisheries Instructure at BC Institute of Technology)*** would like to have presented a brief to the Panel which covers the jetty – causeway issue but he is away on a sabbatical leave in New Zealand. He has advised me to forward his briefs related to the Petronas CEAA review in the Skeena Estuary and the one he prepared for the Fraser Estuary a few years ago. His thorough reviews are separate attachments to this brief and must be examined as related to causeway issues in the Fraser Estuary.

This RBT2 has not properly covered the threat to fish habitats as caused by such barriers and how their impacts can and should be reduced.

d. Growth of TEUs and YVR passengers and jet fuel use.

The EIS for RBT2 looks little different from the one the Vancouver Airport Fuel Facilities Corp. (VAFFC) used when projecting growth of their facilities over the next few decades. The projections are always on the increase to promote a growth at all costs economy and at times is probably empire building.

How can anyone properly project unlimited growth for almost any part of our physical works based economy when we have to address climate change and species extinctions well before 2030? What makes this even more urgent is that few governments and societies seem to bee showing much interest in addressing these anthropogenic created impacts on our atmosphere and species of life. How is excessive development of the Port at this time related to what must take place in government actions and in human behaviour over the next decade?

It is appreciated that many will live in denial of these problems and near impossible challenges and expects others to deal with the problem and /or wait for slow acting governments to take quick action. The Panel's considerations are indeed part of this global problem and it has to be addressed in this project review.

Token responses to these great challenges are often offered. For instance ships will use better fuel when close to port. Ships at the dock can hookup to shoreline power – wherever that comes from and what ecological footprint that electrical production makes elsewhere in the biosphere. These small improvements will do very little to address what is a monumental challenge for all of us.

The late ***Richard Boking*** put it best in his book ***(Mighty River – Portrait of the Fraser. Douglas and McIntyre, Vancouver. 1997)***. He said growth projections for various

developments including population growth in the Lower Fraser River are just that. They are projections made under the best growth scenarios and then become "self-fulfilling prophecies." Governments and industry then work hard to promote that growth to fulfil that projection.

Fourty years ago the federal government undertook a West Coast oil ports commission ***(Thompson, Andrew. 1978. West Coast Oil Ports Inquiry – Statement of Proceedings. 156p. Vancouver. BC).*** That commission was similar to the one that should now be taking place to examine west coast cargo port needs. When it came to predicting oil port needs Thompson stated *"...it is clear that forecasting is more of an art than a science. The most important thing to know about any particular energy is its many policy assumptions, for future energy requirement depend in large measure on policy decisions at all levels of society; for example, policy on supply development, on pricing, on conservation standards."* These words of four decades ago seem to apply to the present time.

It should also be noted that many growth projects are done under the guise that if you do not grow you will die. Further one must grow to be competitive and as YVR and the Port have stated, they want to be leaders in their field. To address the growth projections and your empire you go out of your way to attract business. It was noted by the Tacoma and Seattle container ports that VC ports were taking away from their container business. The American ports determined they had to have a strategy and formed a joint committee to prevent their business going to Vancouver.

From the Vancouver Sun Oct 8, 2014

U.S. Ports Co-operate to Compete with BC.

"The ports of Seattle and Tacoma, Wash. said they will unify management of marine cargo terminals amid heightened competition form B.C. gateways. The alliance will oversee investments, operations, planning and marketing at cargo terminal, the ports said in a joint statement Tuesday."

e. Mitigation, compensation and negligible impacts.

As in other Fraser and Skeena Rivers recent EISs the term 'mitigation' of impacts to result in 'negligible impact' is near the best and most repeated line consultants can use. Under certain reviews if the proponent can show no residual impact that perturbation does not have to be considered as having added to a cumulative impact. A great deal of myth and often poor science is used in this very important discussion in that it has evolved more from a science into a sport.

As noted above the loss of living space and the barriers to water, sediment and fish movements have not and probably cannot be mitigated to a negligible level i.e. no measurable impact. Indeed the Port seems to think that one can destroy sub-tidal

habitat because it is not that important (vs. biofilm or marshes) and one can then offset those losses (i.e. mitigate them) by building opportunistic marshes elsewhere in the estuary. This is offsite compensation for like to unlike habitat. This habitat banking by the Port with DFO approval should have been a key part of this EIS CEAA Panel Review including the impacts caused by those habitat banking projects.

f. The Port (VFPA) a special case that needs special consideration.

At a public information meeting in 2011 related to the proposal by the Vancouver Airport Fuel Facilities Corp. to build a jet fuel terminal in the heart of the Fraser Estuary and have barges and tankers of highly toxic and flammable jet fuel come up the Fraser River upstream of the George Massey Tunnel. At that meeting a director of environment for the Port noted to me off the record that if the jet fuel project was approved that was just the tip of the iceberg in that one would be shocked to see the development plans the port had for the Lower Fraser River.

That jet fuel facility was given an environmental certificate by the BC EAO even though most impacts related to federal responsibilities. The Port then rubber stamped the BC approval and benefited by leasing out land to the fuel corporation. If this does not provide a hint of bias towards development, what does? The Port was in a huge conflict of interest in that they negated a proper federal environmental review (improperly delegated to them by the federal government) and then they would harvest revenue when the project leased their land.

Further to the above, the Harbour Master refused to consider what cargo ships carried and ignored the fact that the jet fuel proposal was based on the transport and handling of a very toxic and highly flammable cargo in the heart of the estuary. At a meeting with VAPOR *the Harbour Master (Capt. Yoss Leclerc - June 25, 2012)* was emphatic that the Port would not consider what was in any tanker or ship in that the Port was only responsible for safe ship traffic. He further said that it was a political decision as to what could be transported in a ship. Leclerc further noted that shipping and river safety was “none of the business” of the BC EAO. It was that provincial process that the Port delegated the EIS review to.

This was a betrayal to any proper EIA and the government and CEAA and the BC EAO allowed it to happen. This was a grave injustice to nature and the life of the Fraser River and a grave risk to the overall estuary including aquatic life, enjoyment of life and property. In 2019 is the Port still caught up in the same arrogant attitudes and callous disregard for the environment and due process?

Further to the above the Port was also totally held the public consultation process in contempt. When VAPOR asked for the biofilm studies, Environment Canada said the Port was the federal lead and all information was to be released by the Port. Upon contacting the Port they insisted that these were not their studies and we had to get

them from EC. We never received the studies for review until after the environmental certificate was issued. Again it this the way the Port will respond to the public in the post 2019 RBT2 period?

Finally it must be noted that the CCEA process (then FEARO – RSCC) was more credible and trusted in 1988 than now. The VAFFC applied for an approval to build a jet fuel terminal on the North Arm of the Fraser River. Although the facility was much smaller than in the 2010 proposal the CEAA RSCC Panel (after public hearings) rejected the proposal as having too great a risk to the fish and wildlife resources in the estuary *(Fed. Envir. Assess. Review Process. 1988. Sea Island Fuel Barge Facility: Report of the Environmental Assessment Panel. 33p. Hull, Que. CDN.)* Why did we have better environmental protection in 1988 than we now do?

CEAA must realize that they are not dealing with a normal project and with a normal project proponent. VFPA is indeed the wolf guarding the sheep. They act as a developer, port operator, land lord, environmental assessment agency and project approval authority. They cannot to be trusted by the public.

Due to deliberate or naive government decisions the Port now administers the old FREMP project coordination activities. The Port pretends that they can now fulfil this role as a neutral broker. This is a ridiculous situation. This issue requires a long discussion and serious thought so the reader is asked to refer to the attached FREMP review *(Langer, O., History and Outcomes of the FREMP and BIEAP. Richmond, BC. May 2019. 31p.).*

At this time Ottawa is undertaking a review with a plan to upgrade the functioning of these federal port authorities. This review should have been complete before this project was subject to environmental review. To further cast doubt on the trust we can put into anything PV does, one must look at their record of cooperation with the public and local government and the repeated claims of the Minister in charge of federal ports (Marc Garneau) that the PV is an independent agency and not under the control of the federal government. Who are they?

g. Recommended lines of thought and actions for the RBT2 Review:

This Panel will hear all about the ‘science’ that says filling in a giant part of an estuary, (that is under great duress) will have insignificant impacts or can be mitigated and therefore have negligible impacts and therefore not be subject to cumulative impacts.

Many public groups and ENGOs will reflect the concerns expressed by Boundary Bay Conservation, Fraser Voices, and APE etc. The Panel will find itself between a rock and a hard place. There will be no simple solutions and to simply approve a project with countless condition that should be met may well be an abdication of responsibility. Its

time CEAA stood up and sent the government a message – science will not rationalize the Prime Minister's empty claim that we can grow the economy and protect the environment. This is as the government does little to advance environmental protection in Canada. This loss of reality or wishful thinking cannot be applied to a major project in the middle of a globally significant estuary - the Fraser Estuary.

h. Conclusions and Rcommendations:

The following are the overarching issues, conclusions and recommendations that must be considered by CEAA RBT2 Panel as they are all directly or indirectly related to any impacts from this port project and required government actions. The conclusions and recommendations are listed from 1, (most immediate action) to 16 (urgent but can be approached with less urgency).

1. RBT2 approval must be delayed. Considering the endless list of concerns and threats faced by the estuary and its life and questions relating to the long term economy in the face of climate change and species loss, the Panel must put this projects approval in abeyance for now. Once there is some clarity where our future will lie in some 10 years or so, then the government can make a more intelligent decision. Do we want or can the planet support more shipping, more consumerism, fossil fuel use, etc. Then this project can be properly and scientifically related to climate change and species and habitat losses.

2. Federal delegation of environmental and social impacts reviews to the Port is an obvious conflict of interest in that the port promotes such development, profits from it and also now reviews and approves it (RBT2 being an exception). A neutral federal agency (a revitalized CEAA) must take over the review of all significant Port area projects.

3. The present EIS approach lines the pockets of consultants as proponents shop for 'science' that favours their project approval. Again CEAA must upgrade its legislation and expertise and set a cost for an EIS, obtain the monies to do the project form the proponent and then contract a neutral agency to do the studies and EIS. Values are important in an EIS in that science must no longer a simple pass and the government has to determine what is fake or junk science and assure fact based science that can withstand peer review.

4. To prevent the Port from working in isolation and in competition with other port facilities on the Westcoast, the government has to put in place an authority to coordinate all port needs and develop new infrastructure where it will aid the economy and do the least damage to the environment.

5. Port efforts to obtain and set aside natural habitats and farmland for future industrial purposes is bound to undermine those renewable resources. The attempt by the Port to be an industrial landlord must be questioned. If additional industrial lands are to be found, this

must be done in cooperation with all governments and the public and be accompanied by measures to enhance existing farmland and remnant habitats.

6. CEAA, SARA, and NWA and the Fisheries Act have been watered down by the past Conservative government so they have little effect on almost any development proposal in this critical environment and its fish and wildlife habitat areas. What we now have should not be the standard upon which this Panel will make its decisions.

7. Proposed CEAA upgrading has gone off the tracks and has to be upgraded so as to address projects that have sensitivity to the habitat affected and the nature of the development and not necessarily its size regardless of siting location. An EIS should be just that and not a review to cover all of society's concerns.

8. It is urgent that the government restore DFO and EC as effective conservation agencies with a politically directed will to do their job. Further to the above, the removal of habitat protection from the Fisheries Act (2012) and the directing of Fishery Officers and remaining habitat from doing any habitat enforcement work must be reversed. The habitat provisions (HADD) must be immediately re-inserted into the Fisheries Act. This habitat law and environmental assessments did exist while Canadiaan industrial development and the economy grew during the 1976 to 2012 time period.

9. Address climate change in a time effective manner so present living resources are not lost in the next few decades as we wait for ineffective controls to be implemented and take effect. The economy, RBT2 and other related issues mean little to society if political leadership continues to fail in this task.

10. Create a fully functional FREMP type organization to coordinate the environmental protection needs of the various federal, provincial, and local government laws and regulations has to be restored since it was dissolved by the past Conservative Government.

11. There is a complete lack of an environmental management body and plan for the Fraser River Delta including the river upstream to Hope. This area is home to over 3,000,000 people with various demands on the river, riparian areas and the estuary. This plan has to be far reaching including environmental protection and restoration, flood control, climate change and population and industrial growth.

12. Further to 11 and 12, the Panel can and should recommend that all levels of government show some initiative to select the Lower Fraser and its estuary as a world class example of long term planning and action to make it truly sustainable in terms of environmental, social and economic needs. This would have to be initiated by government cooperation and a massive study and a plan that can and will be implemented. It will involve a great deal of original work, cross countless jurisdictional boundaries and cost millions of dollars.

13. It is extremely unusual that much of the Lower Fraser is federal port, under federal navigation laws under federal pilotage authority and is home to federally protected habitat and fish and migratory wildlife resources and home to several federal conservation areas. Yet after 2012 the Federal government sees itself as withdrawing from leading in environmental review of impacts in this key and essential habitat area that is of global significance. The federal government did a much more effective job of protecting social and environmental attributes of this area in the 1980s under the EARP – FEARO process before the development of proper legislation (CEAA) to do this job. However, CEAA was effective until about 2012 when its role as related to NWPA and the Fisheries Act was totally undermined by the Conservative government. This problem has to be urgently corrected.

14. If RBT2 is a harmonized or substitute review where is the Province? We now have a BC EAO environmental assessment process that is largely ineffective in directly addressing the real threats of a project that may be planned for the wrong rationale in the wrong location. The BC EAO has many shortcomings including low bar standards that are applied to all projects regardless of habitat sensitivity, lack of follow-up enforcement and a process that allows for no public hearings and thereby eliminates fair public consultation and input. The federal government must drop their dependence on the ineffective BC process of doing EAs that should be done by the federal government in a much more effective manner.

15. Harmonized federal/provincial environmental assessments have failed to credibly meet CEAA requirements and public expectations. Changes made in 2012 to the CEAA have allowed several projects to proceed in B.C. through "substitution". The changes permitted the replacement of the federal EA process with the provincial EAO (i.e., one EA process and both the provincial and federal ministers render a decision on the result), or "equivalency" (i.e., one EA process and a provincial decision only) on request from the B.C. government. The LNG proponents were advised by lawyers that*: "The key to this strategy is to avoid an EA that encompasses additional associated project components, such as pipeline and/or power, and focus on the provincial EA process as the principal venue…*

It is urged that he RBT2 Panel see this as their opportunity to accept the UN realization that our environment and viable populations of nature's life are at a tipping point. This is an opportunity to draw a line in the sand to cause government to take notice. Now is the time to act if life on this planet and the Fraser Estuary is important and to add meaning to the amorphous concept of sustainable development.

Report prepared by

Otto E. Langer BSc(Zool) MSc
Fisheries Biologist and Aquatic Ecologist
ottolanger@telus.net

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ATTACHMENT:

Global Assessment Report produced by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

Current global response insufficient;

'Transformative changes' needed to restore and protect nature;

Opposition from vested interests can be overcome for public good

Most comprehensive assessment of its kind;

1,000,000 species threatened with extinction

PARIS, 6 May – Nature is declining globally at rates unprecedented in human history – and the rate of species extinctions is accelerating, with grave impacts on people around the world now likely, warns a landmark new report from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the summary of which was approved at the 7th session of the IPBES Plenary, meeting last week (29 April – 4 May) in Paris.

"The overwhelming evidence of the IPBES Global Assessment, from a wide range of different fields of knowledge, presents an ominous picture," said IPBES Chair, Sir Robert Watson. "The health of ecosystems on which we and all other species depend is deteriorating more rapidly than ever. We are eroding the very foundations of our economies, livelihoods, food security, health and quality of life worldwide."

"The Report also tells us that it is not too late to make a difference, but only if we start now at every level from local to global," he said. "Through 'transformative change', nature can still be conserved, restored and used sustainably – this is also key to meeting most other global goals. By transformative change, we mean a fundamental, system-wide reorganization across technological, economic and social factors, including paradigms, goals and values."

"The member States of IPBES Plenary have now acknowledged that, by its very nature, transformative change can expect opposition from those with interests vested in the status quo, but also that such opposition can be overcome for the broader public good," Watson said.

The IPBES Global Assessment Report on Biodiversity and Ecosystem Services is the most comprehensive ever completed. It is the first intergovernmental Report of its kind and builds on the landmark Millennium Ecosystem Assessment of 2005, introducing innovative ways of evaluating evidence.

Compiled by 145 expert authors from 50 countries over the past three years, with inputs from another 310 contributing authors, the Report assesses changes over the past five decades, providing a comprehensive picture of the relationship between economic development pathways and their impacts on nature. It also offers a range of possible scenarios for the coming decades.

Based on the systematic review of about 15,000 scientific and government sources, the Report also draws (for the first time ever at this scale) on indigenous and local knowledge, particularly addressing issues relevant to Indigenous Peoples and Local Communities.

"Biodiversity and nature's contributions to people are our common heritage and humanity's most important life-supporting 'safety net'. But our safety net is stretched almost to breaking point," said Prof. Sandra Díaz (Argentina), who co-chaired the Assessment with Prof. Josef Settele (Germany) and Prof. Eduardo S. Brondízio (Brazil and USA).

"The diversity within species, between species and of ecosystems, as well as many fundamental contributions we derive from nature, are declining fast, although we still have the means to ensure a sustainable future for people and the planet."

The Report finds that around 1 million animal and plant species are now threatened with extinction, many within decades, more than ever before in human history.

The average abundance of native species in most major land-based habitats has fallen by at least 20%, mostly since 1900. More than 40% of amphibian species, almost 33% of reef-forming corals and more than a third of all marine mammals are threatened. The picture is less clear for insect species, but available evidence supports a tentative estimate of 10% being threatened. At least 680 vertebrate species had been driven to extinction since the 16th century and more than 9% of all domesticated breeds of mammals used for food and agriculture had become extinct by 2016, with at least 1,000 more breeds still threatened.

"Ecosystems, species, wild populations, local varieties and breeds of domesticated plants and animals are shrinking, deteriorating or vanishing. The essential, interconnected web of life on Earth is getting smaller and increasingly frayed," said Prof. Settele. "This loss is a direct result of human activity and constitutes a direct threat to human well-being in all regions of the world."

To increase the policy-relevance of the Report, the assessment's authors have ranked, for the first time at this scale and based on a thorough analysis of the available evidence, the five direct drivers of change in nature with the largest relative global impacts so far. These culprits are, in descending order: (1) changes in land and sea use; (2) direct exploitation of organisms; (3) climate change; (4) pollution and (5) invasive alien species.

The Report notes that, since 1980, greenhouse gas emissions have doubled, raising average global temperatures by at least 0.7 degrees Celsius – with climate change already impacting nature from the level of ecosystems to that of genetics – impacts expected to increase over the coming decades, in some cases surpassing the impact of land and sea use change and other drivers.

Despite progress to conserve nature and implement policies, the Report also finds that global goals for conserving and sustainably using nature and achieving sustainability cannot be met by current trajectories, and goals for 2030 and beyond may only be achieved through transformative changes across economic, social, political and technological factors. With good progress on components of only four of the 20 Aichi Biodiversity Targets, it is likely that most will be missed by the 2020 deadline. Current negative trends in biodiversity and ecosystems will undermine progress towards 80% (35 out of 44) of the assessed targets of the Sustainable Development Goals, related to poverty, hunger, health, water, cities, climate, oceans and land (SDGs 1, 2, 3, 6, 11, 13, 14 and 15). Loss of biodiversity is therefore shown to be not only an environmental issue, but also a developmental, economic, security, social and moral issue as well.

"To better understand and, more importantly, to address the main causes of damage to biodiversity and nature's contributions to people, we need to understand the history and global interconnection of complex demographic and economic indirect drivers of change, as well as the social values that underpin them," said Prof. Brondízio. "Key indirect drivers include increased population and per capita consumption; technological innovation, which in some cases has lowered and in other cases increased the damage to nature; and, critically, issues of governance and accountability. A

pattern that emerges is one of global interconnectivity and 'telecoupling' – with resource extraction and production often occurring in one part of the world to satisfy the needs of distant consumers in other regions."

Other notable findings of the Report include:

- Three-quarters of the land-based environment and about 66% of the marine environment have been significantly altered by human actions. On average these trends have been less severe or avoided in areas held or managed by Indigenous Peoples and Local Communities.
- More than a third of the world's land surface and nearly 75% of freshwater resources are now devoted to crop or livestock production.
- The value of agricultural crop production has increased by about 300% since 1970, raw timber harvest has risen by 45% and approximately 60 billion tons of renewable and nonrenewable resources are now extracted globally every year – having nearly doubled since 1980.
-  Land degradation has reduced the productivity of 23% of the global land surface, up to US$577 billion in annual global crops are at risk from pollinator loss and 100-300 million people are at increased risk of floods and hurricanes because of loss of coastal habitats and protection.
- In 2015, 33% of marine fish stocks were being harvested at unsustainable levels; 60% were maximally sustainably fished, with just 7% harvested at levels lower than what can be sustainably fished.
- Urban areas have more than doubled since 1992.
- Plastic pollution has increased tenfold since 1980, 300-400 million tons of heavy metals, solvents, toxic sludge and other wastes from industrial facilities are dumped annually into the world's waters, and fertilizers entering coastal ecosystems have produced more than 400 ocean 'dead zones', totalling more than 245,000 km2 (591-595) – a combined area greater than that of the United Kingdom.
-  Negative trends in nature will continue to 2050 and beyond in all of the policy scenarios explored in the Report, except those that include transformative change – due to the projected impacts of increasing land-use change, exploitation of organisms and climate change, although with significant differences between regions.

The Report also presents a wide range of illustrative actions for sustainability and pathways for achieving them across and between sectors such as agriculture, forestry, marine systems, freshwater systems, urban areas, energy, finance and many others. It highlights the importance of, among others, adopting integrated management and cross-sectoral

approaches that take into account the trade-offs of food and energy production, infrastructure, freshwater and coastal management, and biodiversity conservation.

Also identified as a key element of more sustainable future policies is the evolution of global financial and economic systems to build a global sustainable economy, steering away from the current limited paradigm of economic growth.

"IPBES presents the authoritative science, knowledge and the policy options to decision-makers for their consideration," said IPBES Executive Secretary, Dr. Anne Larigauderie. "We thank the hundreds of experts, from around the world, who have volunteered their time and knowledge to help address the loss of species, ecosystems and genetic diversity – a truly global and generational threat to human well-being."

Further Information on Key Issues from the Report

Scale of Loss of Nature

- Gains from societal and policy responses, while important, have not stopped massive losses.
- Since 1970, trends in agricultural production, fish harvest, bioenergy production and harvest of materials have increased, in response to population growth, rising demand and technological development, this has come at a steep price, which has been unequally distributed within and across countries. Many other key indicators of nature's contributions to people however, such as soil organic carbon and pollinator diversity, have declined, indicating that gains in material contributions are often not sustainable .
- The pace of agricultural expansion into intact ecosystems has varied from country to country. Losses of intact ecosystems have occurred primarily in the tropics, home to the highest levels of biodiversity on the planet. For example, 100 million hectares of tropical forest were lost from 1980 to 2000, resulting mainly from cattle ranching in Latin America (about 42 million hectares) and plantations in South-East Asia (about 7.5 million hectares, of which 80% is for palm oil, used mostly in food, cosmetics, cleaning products and fuel) among others.
- Since 1970 the global human population has more than doubled (from 3.7 to 7.6 billion), rising unevenly across countries and regions; and per capita gross domestic product is four times higher – with ever-more distant consumers shifting the environmental burden of consumption and production across regions.
- The average abundance of native species in most major land-based habitats has fallen by at least 20%, mostly since 1900.
- The numbers of invasive alien species per country have risen by about 70% since 1970, across the 21 countries with detailed records.
- The distributions of almost half (47%) of land-based flightless mammals, for example, and almost a quarter of threatened birds, may already have been negatively affected by climate change.

Indigenous Peoples, Local Communities and Nature

- At least a quarter of the global land area is traditionally owned, managed, used or occupied by Indigenous Peoples. These areas include approximately 35% of the area that is formally protected, and approximately 35% of all remaining terrestrial areas with very low human intervention.
- Nature managed by Indigenous Peoples and Local Communities is under increasing pressure but is generally declining less rapidly than in other lands – although 72% of local indicators developed and used by Indigenous Peoples and Local Communities show the deterioration of nature that underpins local livelihoods.

- The areas of the world projected to experience significant negative effects from global changes in climate, biodiversity, ecosystem functions and nature's contributions to people are also areas in which large concentrations of Indigenous Peoples and many of the world's poorest communities reside.
- Regional and global scenarios currently lack and would benefit from an explicit consideration of the views, perspectives and rights of Indigenous Peoples and Local Communities, their knowledge and understanding of large regions and ecosystems, and their desired future development pathways. Recognition of the knowledge, innovations and practices, institutions and values of Indigenous Peoples and Local Communities and their inclusion and participation in environmental governance often enhances their quality of life, as well as nature conservation, restoration and sustainable use. Their positive contributions to sustainability can be facilitated through national recognition of land tenure, access and resource rights in accordance with national legislation, the application of free, prior and informed consent, and improved collaboration, fair and equitable sharing of benefits arising from the use, and co-management arrangements with local communities.

Global Targets and Policy Scenarios

- Past and ongoing rapid declines in biodiversity, ecosystem functions and many of nature's contributions to people mean that most international societal and environmental goals, such as those embodied in the Aichi Biodiversity Targets and the 2030 Agenda for Sustainable Development will not be achieved based on current trajectories.
- The authors of the Report examined six policy scenarios – very different 'baskets' of clustered policy options and approaches, including 'Regional Competition', 'Business as Usual' and 'Global Sustainability' – projecting the likely impacts on biodiversity and nature's contributions to people of these pathways by 2050. They concluded that, except in scenarios that include transformative change, the negative trends in nature, ecosystem functions and in many of nature's contributions to people will continue to 2050 and beyond due to the projected impacts of increasing land and sea use change, exploitation of organisms and climate change.

Policy Tools, Options and Exemplary Practices

- Policy actions and societal initiatives are helping to raise awareness about the impact of consumption on nature, protecting local environments, promoting sustainable local economies and restoring degraded areas. Together with initiatives at various levels these have contributed to expanding and strengthening the current network of ecologically representative and well-connected protected area networks and other effective area-based conservation measures, the protection of watersheds and incentives and sanctions to reduce pollution .
- The Report presents an illustrative list of possible actions and pathways for achieving them across locations, systems and scales, which will be most likely to support sustainability. Taking an integrated approach:
- In ***agriculture***, the Report emphasizes, among others: promoting good agricultural and agroecological practices; multifunctional landscape planning (which simultaneously provides food security, livelihood opportunities, maintenance of species and ecological functions) and cross-sectoral integrated management. It also points to the importance of deeper engagement of all actors throughout the food system (including producers, the public sector, civil society and consumers) and more integrated landscape and watershed management; conservation of the diversity of genes, varieties, cultivars, breeds, landraces and species; as well as approaches that empower consumers and producers through market transparency, improved distribution and localization (that revitalizes local economies), reformed supply chains and reduced food waste.
- In ***marine systems***, the Report highlights, among others: ecosystem-based approaches to fisheries management; spatial planning; effective quotas; marine protected areas; protecting and managing key marine biodiversity areas; reducing run- off pollution into oceans and working closely with producers and consumers.
- In ***freshwater systems***, policy options and actions include, among others: more inclusive water governance for collaborative water management and greater equity; better integration of water resource management and landscape planning across scales; promoting practices to reduce soil erosion, sedimentation and pollution run-off; increasing water storage; promoting investment in water projects with clear sustainability criteria; as well as addressing the fragmentation of many freshwater policies.
- In ***urban areas***, the Report highlights, among others: promotion of nature-based solutions; increasing access to urban services and a healthy urban environment for low-income communities; improving access to green

spaces; sustainable production and consumption and ecological connectivity within urban spaces, particularly with native species.

- Across all examples, the Report recognises the importance of including different value systems and diverse interests and worldviews in formulating policies and actions. This includes the full and effective participation of Indigenous Peoples and Local Communities in governance, the reform and development of incentive structures and ensuring that biodiversity considerations are prioritised across all key sector planning.
- "We have already seen the first stirrings of actions and initiatives for transformative change, such as innovative policies by many countries, local authorities and businesses, but especially by young people worldwide," said Sir Robert Watson. "From the young global shapers behind the #VoiceforthePlanet movement, to school strikes for climate, there is a groundswell of understanding that urgent action is needed if we are to secure anything approaching a sustainable future. The IPBES Global Assessment Report offers the best available expert evidence to help inform these decisions, policies and actions – and provides the scientific basis for the biodiversity framework and new decadal targets for biodiversity, to be decided in late 2020 in China, under the auspices of the UN Convention on Biological Diversity."

By the Numbers – Key Statistics and Facts from the Report

General

- 75%: terrestrial environment "severely altered" to date by human actions (marine environments 66%)
- 47%: reduction in global indicators of ecosystem extent and condition against their estimated natural baselines, with many continuing to decline by at least 4% per decade
- 28%: global land area held and/or managed by Indigenous Peoples , including >40% of formally protected areas and 37% of all remaining terrestrial areas with very low human intervention
- +/-60 billion: tons of renewable and non-renewable resources extracted globally each year, up nearly 100% since 1980
- 15%: increase in global per capita consumption of materials since 1980
- >85%: of wetlands present in 1700 had been lost by 2000 – loss of wetlands is currently three times faster, in percentage terms, than forest loss.

Species, Populations and Varieties of Plants and Animals

- 8 million: total estimated number of animal and plant species on Earth (including 5.5 million insect species)
- Tens to hundreds of times: the extent to which the current rate of global species extinction is higher compared to average over the last 10 million years, and the rate is accelerating
- Up to 1 million: species threatened with extinction, many within decades
- >500,000 (+/-9%): share of the world's estimated 5.9 million terrestrial species with insufficient habitat for long term survival without habitat restoration
- >40%: amphibian species threatened with extinction
- Almost 33%: reef forming corals, sharks and shark relatives, and >33% marine mammals threatened with extinction
- 25%: average proportion of species threatened with extinction across terrestrial, freshwater and marine vertebrate, invertebrate and plant groups that have been studied in sufficient detail
- At least 680: vertebrate species driven to extinction by human actions since the 16th century
- +/-10%: tentative estimate of proportion of insect species threatened with extinction
- >20%: decline in average abundance of native species in most major terrestrial biomes, mostly since 1900
  +/-560 (+/-10%): domesticated breeds of mammals were extinct by 2016, with at least 1,000 more threatened
- 3.5%: domesticated breed of birds extinct by 2016
- 70%: increase since 1970 in numbers of invasive alien species across 21 countries with detailed records
- 30%: reduction in global terrestrial habitat integrity caused by habitat loss and deterioration
- 47%: proportion of terrestrial flightless mammals and 23% of threatened birds whose distributions may have been negatively impacted by climate change already

- >6: species of ungulate (hoofed mammals) would likely be extinct or surviving only in captivity today without conservation measures

Food and Agriculture

- 300%: increase in food crop production since 1970
- 23%: land areas that have seen a reduction in productivity due to land degradation
- >75%: global food crop types that rely on animal pollination
- US$235 to US$577 billion: annual value of global crop output at risk due to pollinator loss
- 5.6 gigatons: annual CO2 emissions sequestered in marine and terrestrial ecosystems – equivalent to 60% of global fossil fuel emission
- +/-11%: world population that is undernourished
- 100 million: hectares of agricultural expansion in the tropics from 1980 to 2000, mainly cattle ranching in Latin America (+/-42 million ha), and plantations in Southeast Asia (+/-7.5 million ha, of which 80% is oil palm), half of it at the expense of intact forests
- 3%: increase in land transformation to agriculture between 1992 and 2015, mostly at the expense of orests
- >33%: world's land surface (and +/-75% of freshwater resources) devoted to crop or livestock production
- 12%: world's ice-free land used for crop production
- 25%: world's ice-free land used for grazing (+/-70% of drylands)
- +/-25%: greenhouse gas emissions caused by land clearing, crop production and fertilization, with animal-based food contributing 75% to that figure
- +/-30%: global crop production and global food supply provided by small land holdings (<2 ha), using +/-25% of agricultural land, usually maintaining rich agrobiodiversity
- $100 billion: estimated level of financial support in OECD countries (2015) to agriculture that is potentially harmful to the environment

Oceans and Fishing

- 33%: marine fish stocks in 2015 being harvested at unsustainable levels; 60% are maximally sustainably fished; 7% are underfished
- >55%: ocean area covered by industrial fishing
- 3-10%: projected decrease in ocean net primary production due to climate change alone by the end of the century
- 3-25%: projected decrease in fish biomass by the end of the century in low and high climate warming scenarios, respectively
- >90%: proportion of the global commercial fishers accounted for by small scale fisheries (over 30 million people) – representing nearly 50% of global fish catch
- Up to 33%: estimated share in 2011 of world's reported fish catch that is illegal, unreported or unregulated
- >10%: decrease per decade in the extent of seagrass meadows from 1970-2000
- +/-50%: live coral cover of reefs lost since 1870s
- 100-300 million: people in coastal areas at increased risk due to loss of coastal habitat protection
- 400: low oxygen (hypoxic) coastal ecosystem 'dead zones' caused by fertilizers, affecting >245,000 km2
- 29%: average reduction in the extinction risk for mammals and birds in 109 countries thanks to conservation investments from 1996 to 2008; the extinction risk of birds, mammals and amphibians would have been at least 20% greater without conservation action in recent decade
- >107: highly threatened birds, mammals and reptiles estimated to have benefitted from the eradication of invasive mammals on islands

Forests

- 45%: increase in raw timber production since 1970 (4 billion cubic meters in 2017)
- +/-13 million: forestry industry jobs
- 50%: agricultural expansion that occurred at the expense of forests
- 50%: decrease in net rate of forest loss since the 1990s (excluding those managed for timber or agricultural extraction)
- 68%: global forest area today compared with the estimated pre-industrial level
- 7%: reduction of intact forests (>500 sq. km with no human pressure) from 2000-2013 in developed and developing countries
- 290 million ha (+/-6%): native forest cover lost from 1990-2015 due to clearing and wood harvesting
- 110 million ha: rise in the area of planted forests from 1990-2015
- 10-15%: global timber supplies provided by illegal forestry (up to 50% in some areas)
- >2 billion: people who rely on wood fuel to meet their primary energy needs

Mining and Energy

- <1%: total land used for mining, but the industry has significant negative impacts on biodiversity, emissions, water quality and human health
- +/-17,000: large-scale mining sites (in 171 countries), mostly managed by 616 international corporations
- +/-6,500: offshore oil and gas ocean mining installations ((in 53 countries)
- US$345 billion: global subsidies for fossil fuels resulting in US$5 trillion in overall costs, including nature deterioration externalities; coal accounts for 52% of post-tax subsidies, petroleum for +/-33% and natural gas for +/-10%

Urbanization, Development and Socioeconomic Issues

- >100%: growth of urban areas since 1992
- 25 million km: length of new paved roads foreseen by 2050, with 90% of construction in least developed and developing countries
- +/-50,000: number of large dams (>15m height) ; +/-17 million reservoirs (>0.01 ha)
- 105%: increase in global human population (from 3.7 to 7.6 billion) since 1970 unevenly across countries and regions
- 50 times higher: per capita GDP in developed vs. least developed countries
- >2,500: conflicts over fossil fuels, water, food and land currently occurring worldwide
- >1,000: environmental activists and journalists killed between 2002 and 2013

Health

- 70%: proportion of cancer drugs that are natural or synthetic products inspired by nature
- +/-4 billion: people who rely primarily on natural medicines
- 17%: infectious diseases spread by animal vectors, causing >700,000 annual deaths
- +/-821 million: people face food insecurity in Asia and Africa
- 40%: of the global population lacks access to clean and safe drinking water
- >80%: global wastewater discharged untreated into the environment
- 300-400 million tons: heavy metals, solvents, toxic sludge, and other wastes from industrial facilities dumped annually into the world's waters
- 10 times: increase in plastic pollution since 1980

Climate Change

- 1 degree Celsius: average global temperature difference in 2017 compared to pre-industrial levels, rising +/-0.2 (+/-0.1) degrees Celsius per decade

- >3 mm: annual average global sea level rise over the past two decades
- 16-21 cm: rise in global average sea level since 1900
- 100% increase since 1980 in greenhouse gas emissions, raising average global temperature by at least 0.7 degree
- 40%: rise in carbon footprint of tourism (to 4.5Gt of carbon dioxide) from 2009 to 2013
- 8%: of total greenhouse gas emissions are from transport and food consumption related to tourism
- 5%: estimated fraction of species at risk of extinction from 2°C warming alone, rising to 16% at 4.3°C warming
- Even for global warming of 1.5 to 2 degrees, the majority of terrestrial species ranges are projected to shrink profoundly.

Sustainable Development Goals

- Most: Aichi Biodiversity Targets for 2020 likely to be missed
- 22 of 44: assessed targets under the Sustainable Development Goals related to poverty, hunger, health, water, cities, climate, ocean and land are being undermined by substantial negative trends in nature and its contributions to people
- 72%: of local indicators in nature developed and used by Indigenous Peoples and Local Communities that show negative trends
- 4: number of Aichi Targets where good progress has been made on certain components, with moderate progress on some components of another 7 targets, poor progress on all components of 6 targets, and insufficient information to assess progress on some or all components of the remaining 3 targets

IPBES Partner Comments

"Nature makes human development possible but our relentless demand for the earth's resources is accelerating extinction rates and devastating the world's ecosystems. UN Environment is proud to support the Global Assessment Report produced by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services because it highlights the critical need to integrate biodiversity considerations in global decision-making on any sector or challenge, whether its water or agriculture, infrastructure or business."
– Joyce Msuya, Acting Head, UN Environment

"Across cultures, humans inherently value nature. The magic of seeing fireflies flickering long into the night is immense. We draw energy and nutrients from nature. We find sources of food, medicine, livelihoods and innovation in nature. Our well-being fundamentally depends on nature. Our efforts to conserve biodiversity and ecosystems must be underpinned by the best science that humanity can produce. This is why the scientific evidence compiled in this IPBES Global Assessment is so important. It will help us build a stronger foundation for shaping the post 2020 global biodiversity framework: the 'New Deal for Nature and People'; and for achieving the SDGs."
– Achim Steiner, Administrator, United Nations Development Programme

"This essential report reminds each of us of the obvious truth: the present generations have the responsibility to bequeath to future generations a planet that is not irreversibly damaged by human activity. Our local, indigenous and scientific knowledge are proving that we have solutions and so no more excuses: we must live on earth differently. UNESCO is committed to promoting respect of the living and of its diversity, ecological solidarity with other living species, and to establish new, equitable and global links of partnership and intragenerational solidarity, for the perpetuation of humankind."
– Audrey Azoulay, Director-General, UNESCO

"The IPBES' 2019 Global Assessment Report on Biodiversity and Ecosystem Services comes at a critical time for the planet and all its peoples. The report's findings – and the years of diligent work by the many scientists who contributed – will offer a comprehensive view of the current conditions of global biodiversity. Healthy biodiversity is the essential infrastructure that supports all forms of life on earth, including human life. It also provides nature-based solutions on many of the most critical environmental, economic, and social challenges that we face as human society, including climate change, sustainable development, health, and water and food security. We are currently in the midst of preparing for the 2020 UN Biodiversity Conference, in China, which will mark the close of the Aichi Biodiversity Targets and set the course for a post 2020 ecologically focused sustainable development pathway to deliver multiple benefits for people, the planet and our global economy. The IPBES report will serve as a fundamental baseline of where we are and where we need to go as a global community to inspire humanity to reach the 2050 Vision of the UN Biodiversity Convention "Living in harmony with nature". I want to extend my thanks and congratulations to the IPBES community for their hard work, immense contributions and continued partnership."
– Cristiana Pasca Palmer, Executive Secretary, Convention on Biological Diversity

"The Global Assessment of biodiversity and ecosystem services adds a major element to the body of evidence for the importance of biodiversity to efforts to achieve the Zero Hunger objective and meet the Sustainable Development Goals. Together, assessments undertaken by IPBES, FAO, CBD and other organizations point to the urgent need for action to better conserve and sustainably use biodiversity and to the importance of cross-sectoral and multidisciplinary collaboration among decision-makers and other stakeholders at all levels."
– Jose Graziano da Silva, Director-General, Food and Agriculture Organization of the United Nations