Global Footprint Network®
Advancing the Science of Sustainability

The Ecological Footprint and Biocapacity of California

Produced for the U.S. Environmental Protection Agency

under purchase order EP-11-9-000094

March 2013

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Published in March 2013 by Global Footprint Network, Oakland, California, United States of America. This report utilizes Ecological Footprint and biocapacity data from the 2011 National Ecological Footprint Accounts published by Global Footprint Network.

Foreword: What is at stake?

For most of the 20th century, resources were relatively cheap and easily available. As a result most economies, including California's, became increasingly dependent on large amounts of natural resources — water, fossil fuels and biological resources — and the services that they provide.

While resources are still relatively cheap, the increasing global demand is meeting a supply crunch. It now takes more effort to extract fossil fuels and, in some places, access fresh water, which has greater impact on biodiversity. Agricultural production is also becoming increasingly fuel-intensive. As a consequence, basic commodities, such as food and fibers, are getting more expensive, creating more and more strain on our economies.

California has relatively high average per-person income, so its economy remains less affected by resource constraints than are the economies of many other areas, even given the recent economic turmoil. In regions that don't have California's economic advantage, such as Central America or the Mediterranean basin, resource deficits are already a massive economic burden, amplifying if not driving the turmoil. But even California is experiencing some of the crunch, particularly through energy costs and water shortages. Global climate change will only exacerbate these issues.

This stress is not a short-lived anomaly. The cumulative, persistent trend of resource demand meeting limited supply is turning resource dynamics into an ever-more significant driver of economic performance. Decision-makers who ignore these trends risk social and economic decline.

In order to shift these trends and adjust to new realities, decision-makers need to recognize the speed and scale of the challenge, and the time lags involved. Adapting infrastructure to a resource-constrained world requires foresight and time, as well as solid implementation and monitoring programs.

Understanding speed and scale requires robust information. This is the purpose of this report: To detail California's ecological assets and resource demand with the Ecological Footprint and its supply-side complement, biocapacity.

One significant result of this assessment surprised us: California has little biocapacity per resident. In other words, the ability of the state's ecosystems to provide ecological resources and services is below what Californians consume. California contains just about one-sixth of the ecological resources it demands, even though its per capita Ecological Footprint is somewhat lower than the U.S. average.

In a world of growing ecological overshoot, access to sufficient natural capital is key to success. It is in the overwhelming self-interest of any country, state, city and investor to address resource constraints proactively. California is no exception.

California's Assembly Bill 32 (Global Warming Solutions Act) may in fact be one of the most significant competitiveness drivers for California, even though it only addresses one interwoven portion of the Footprint, namely carbon emissions.

Footprint and biocapacity accounts help provide an overview. They also show what factors drive what kinds of resource demands, and where resource deficits occur. This analysis is just a first summary; more detail could be added, and changes could be evaluated over time.

But the initial point is straightforward: Biocapacity is becoming more critical to economic success in the 21st century, and the state is running a significant resource deficit. California cannot ignore its growing risk exposure. As a global center of innovation, California has the ability to address this challenge. To remain a leader, it must.

Mathis Wackernagel, Ph.D.
President
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Executive summary

The Ecological Footprint for California, as part of the California Sustainability Indicators project undertaken by the U.S. Environmental Protection Agency Region 9, represents a significant development in the use of the Ecological Footprint. This is the first Ecological Footprint study of the state of California.

The **Ecological Footprint** is an accounting tool that measures the amount of biologically productive land and sea area required both to produce what a population (or an activity) consumes and to absorb its waste, using prevailing technology and management practice. The Ecological Footprint is compared to available **biocapacity**, the planet's or a region's biological capacity to provide the products and services people demand.

This is a baseline study undertaken to measure California's Ecological Footprint and biocapacity and to identify the drivers. Data were only available for one year (2008), so time trends cannot be established under the current analysis. Details about the source data and methodology used to determine these results are presented in a separate report[1].

Key findings

- Although California's per capita Ecological Footprint is less than that of the United States, California is still running a significant ecological deficit, with its population using more than five times the biological capacity (or biocapacity) that is available within the state. This means that the state of California consumes renewable biological materials at a rate that is faster than they can be regenerated, and is emitting carbon dioxide into the atmosphere at a rate that is faster than carbon dioxide can be sequestered within California.

- Most of the difference between the national per capita Footprint and California's is due to lower per capita carbon dioxide emissions in California. Some of this difference can be explained by mild weather that reduces energy demand for heating and cooling, by implementation of energy efficiency measures and policies, and by the use of hydropower in California. In addition, California uses natural gas in some places where other states use coal.

- California's per capita biocapacity is much less than that of the United States. This is due mostly to California's relatively high population density, but also to the aridity of much of the state.

[1] Moore, D., Larson, J., Iha, K., Wackernagel, M. 2013. Methodology for calculating the Ecological Footprint of California. Global Footprint Network, Oakland, USA. Report prepared for EPA Region 9.

Even though the agricultural sector of California's economy is robust, the state's cropland biocapacity is relatively small — only 3 percent of the total cropland biocapacity in the United States. Measured in monetary terms, agricultural production in California was 17 percent of the total agriculture economic output of the United States. But while the dollar value of crops produced in California is typically high, biocapacity is based on the physical weight of crops harvested and the area used to grow them. In other words, biocapacity reflects biological productivity, not revenue.

- Even though California has a great deal of biocapacity in fishing grounds and forestland, Californians export much of what is produced with this biocapacity. And though there is a lot of biocapacity within the state, California imports most of the products from fishing grounds and forestland that are consumed by the population.

- Carbon emissions account for 73 percent of California's Ecological Footprint. This is largely driven by transportation, industrial emissions — including electricity generation — and direct domestic use (heating and cooking).

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California Sustainability Indicators

Growing human population, ever-increasing energy and material use, and waste generation characterize our current economic and social systems. Yet ecosystem services that provide materials and absorb waste are limited. Time trends show a widening gap between increasing human demand for these ecosystem services and decreasing ability of nature to support this demand. The U.S. Environmental Protection Agency Region 9 has developed a suite of substantive and informative indicators on economy-environment interactions. Their objective is to facilitate decision-making for the long-term benefit of California.

In addition to the Ecological Footprint, this suite of indicators includes: the Water Footprint, provided by the University of California-Davis; Groundwater Estimates from the Gravity Recovery and Climate Experiment (GRACE), provided by Jet Propulsion Laboratory and California Institute of Technology; and Satellite Indicators of Vegetation Condition, Crop Canopy Development and Agricultural Water Use in California, provided by NASA Ames and California State University-Monterey Bay.

This report presents the baseline Ecological Footprint of California using data from 2008, the most recent year complete data sets were available.

What is the Ecological Footprint?

The **Ecological Footprint** is an accounting tool that measures the amount of biologically productive land and sea area required to produce what a population (or an activity) consumes and to absorb its waste, using prevailing technology and management practice. The Ecological Footprint is compared to available **biocapacity**, the planet's or a region's biological capacity to provide the products and services people demand.

Biologically productive land and sea includes area that 1) supports human demand for food, fiber, timber and space for infrastructure, and 2) absorbs the emitted waste. Current national accounts, as well as this one for California, only include the carbon dioxide emissions from fossil fuel burning on the waste side. With better, internationally comparable data sets, additional waste streams could be included. Biologically productive areas include cropland, grazing land, forest and fishing grounds. Deserts, glaciers and the open ocean are not included.

The Ecological Footprint tracks demand for products that come from five distinct area types: cropland, grazing land, fishing grounds, built-up land and forests. Forests provide two distinct services that compete for space: They generate forest products such as timber and firewood, and they provide CO_2

sequestration for the carbon Footprint. These two services make demands on forests that are typically mutually exclusive, since harvested forest products release the captured CO_2 again, while forests for sequestration need to remain unharvested. Average bioproductivity differs among various area types, as well as among countries for any given area type. For comparability across area types and countries, Ecological Footprint and biocapacity are expressed in units of world-average bioproductive area, referred to as global hectares (gha).

Footprint of consumption, production and trade

The most commonly reported type of Ecological Footprint measures the biocapacity used to support a defined population's consumption. Unless otherwise specified, when you see Ecological Footprint values, they represent the Footprint of consumption.

$$EF_{Consumption} = EF_{Production} + EF_{Imports} - EF_{Exports}$$

The Footprint of consumption (EF_C) is calculated from production and trade flows; it is the Ecological Footprint of all domestic economic production (EF_P, calculated as the Footprint from local biocapacity and of all local carbon dioxide emissions), plus the Footprint embodied in imports (EF_I), less the Footprint embodied in exports (EF_E).

Biocapacity

Biocapacity is a measure of the amount of biologically productive land and sea area available to provide the ecosystem services humanity consumes — our ecological budget or nature's regenerative capacity[2]. California's biocapacity was determined using land cover data as well as data on the average productivity of various land types. The amount of biocapacity can change over time due to increases or decreases in the amount and productivity of the living things in a particular area. All else equal, if resources are degraded, biocapacity will decline, in some cases to the point that no biologically useful material remains for human consumption or to meet the needs of wild species.

[2] For more detail, please refer to Moore, D., Larson, J., Iha, K., Wackernagel, M. 2013. Methodology for calculating the Ecological Footprint of California. Global Footprint Network, Oakland, USA. Report prepared for EPA Region 9.

Summary of area types

Cropland

Cropland is the most bioproductive of all the land-use types. It consists of areas used to produce food and fiber for human consumption, feed for livestock, oil crops and rubber. Current cropland Footprint calculations do not take into account the extent to which farming techniques or unsustainable agricultural practices cause long-term degradation of soil.

Grazing land

Grazing land is used to raise livestock for meat, dairy, hide and wool products. The grazing land Footprint is calculated by comparing the amount of feed crops that are fed to livestock with the total amount required to support livestock. The difference is assumed to come from grazing land.

Fishing grounds

The fishing grounds Footprint is calculated using estimates of the maximum sustainable catch for a variety of fish species. These sustainable catch estimates are converted into an equivalent mass of primary production based on the various species' trophic levels. This estimate of maximum harvestable primary production is then divided among the continental shelf areas of the world.

Fishing grounds Footprint and biocapacity take into account the ocean, inland waterways and aquaculture.

Forest

Forest biocapacity provides for two mutually exclusive demands:

a) Forest product Footprint

The forest product Footprint is calculated based on the amount of lumber, pulp, timber products and fuelwood consumed by a population.

b) Carbon Footprint

Carbon dioxide emissions from burning fossil fuels are the only waste product included in the current national Ecological Footprint methodology. On the demand side, the carbon component of the Ecological Footprint, the carbon Footprint, is calculated as the amount of forestland required to sequester (through photosynthesis) carbon emissions released by humans and not sequestered by oceans. It is the largest portion of humanity's current Footprint, but quite small in some low-income countries.

We use carbon Footprint, the carbon component of the Ecological Footprint, with a more specific meaning than it typically carries in the general literature and the climate debate. In much of the

climate debate, carbon footprint merely refers to the number of tonnes of carbon dioxide, tonnes of CO_2-equivalent, or tonnes of carbon per unit of currency or for an activity. In our case, we translate these tonnes into the corresponding bioproductive area needed for sequestering this amount of CO_2. When used in Ecological Footprint studies, the phrase "carbon Footprint" refers to the pressure placed on biocapacity to sequester (through photosynthesis) the carbon dioxide emissions from fossil fuel combustion[3]. (Its unit of measure is global hectares rather than amounts of CO_2 emissions.)

Because very little forest area is legally dedicated to long-term CO_2 sequestration, we do not distinguish forest for forest products from forest for sequestration. We only report forest area as a whole.

Figure 1 *The Ecological Footprint measures the human demand for energy, infrastructure, food, fiber, timber, paper and seafood. It is compared to biocapacity of five distinct area types: built-up land, grazing land, cropland, forest land and fishing grounds.*

Built-up land

The built-up land Footprint is calculated based on the area of land covered by human infrastructure — transportation, housing, industrial structures and reservoirs for hydropower. Built-up land typically

[3] More precisely, the amount of CO_2 sequestered by oceans and removed by (nonland-based) human intervention is subtracted from fossil fuel-generated CO_2 emission. Additional discussions of the carbon footprint and the carbon component of the Ecological Footprint can be found in: Galli, A.; Wiedmann, T.; Ercin, E.A.; Knoblauch, D.; Ewing, B.; Giljum, S. 2012. Integrating ecological, carbon, and water footprint into a "footprint family" of indicators: Definition and role in tracking human pressure on the planet. Ecological Indicators, 16, 100–112.

occupies what would otherwise be cropland. In our current calculations, to simplify, the built-up land Footprint is always equal to the built-up land biocapacity.

Ecological deficit

Ecological Footprint and biocapacity calculations capture the rate at which renewable biological materials are being produced and used, and the rate at which carbon dioxide emissions are being generated. Data used in the calculations measure five factors that determine supply and demand: land area, biological productivity, population, consumption, and transformation (or resource) efficiency.

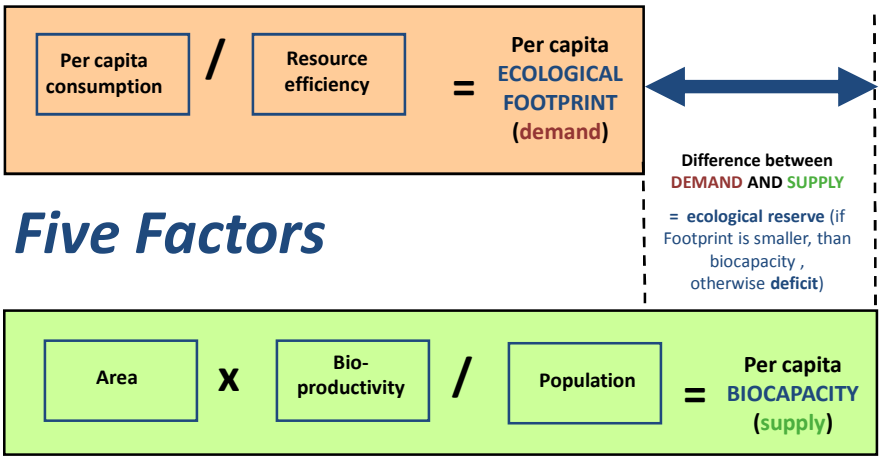

Figure 2 *Five factors determine the ecological reserve (or deficit), the difference between biocapacity and the Ecological Footprint.*

An **ecological deficit** occurs when the Footprint of a population exceeds the biocapacity of the geographic area available to that population. When a region or country is in ecological deficit, it meets demand by importing embedded biocapacity through trade, liquidating its own ecological assets,

and/or using the global commons such as fishing in international waters or polluting CO_2 into the global atmosphere.

In contrast, when there is enough biocapacity to support the population's Ecological Footprint in net terms, there is an ecological reserve.

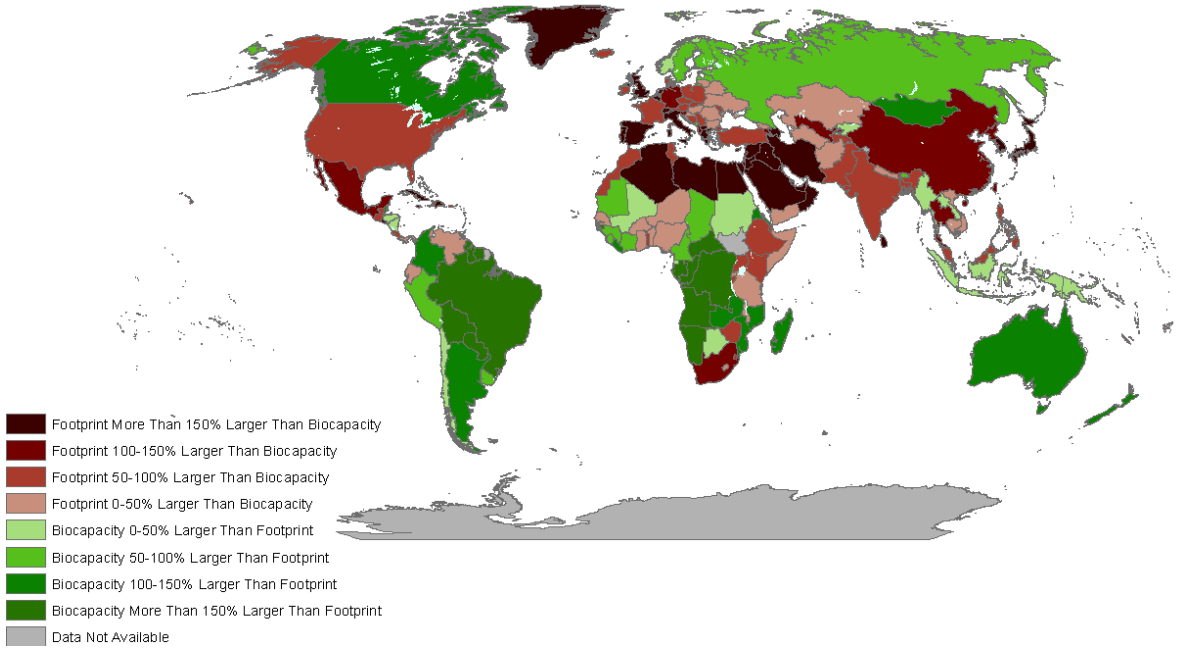

Figure 3 *Ecological creditors (green) and debtors (red) in 2008.*

The United States has run an ecological deficit since at least 1961

The earliest year for which complete national-level data are available is 1961. The United States has had one of the largest Ecological Footprints in the world — in terms of both its total and its average (per capita) Ecological Footprint — for this entire time span.

Even though the per capita Footprint has not increased as significantly or quickly as it has in many other countries, the Ecological Footprint of the United States continues to grow. While individual consumption in the United States continues to rise, population growth is an even more significant driver of the country's total Ecological Footprint, accounting for 86 percent of the increase between 1961 and 2008.

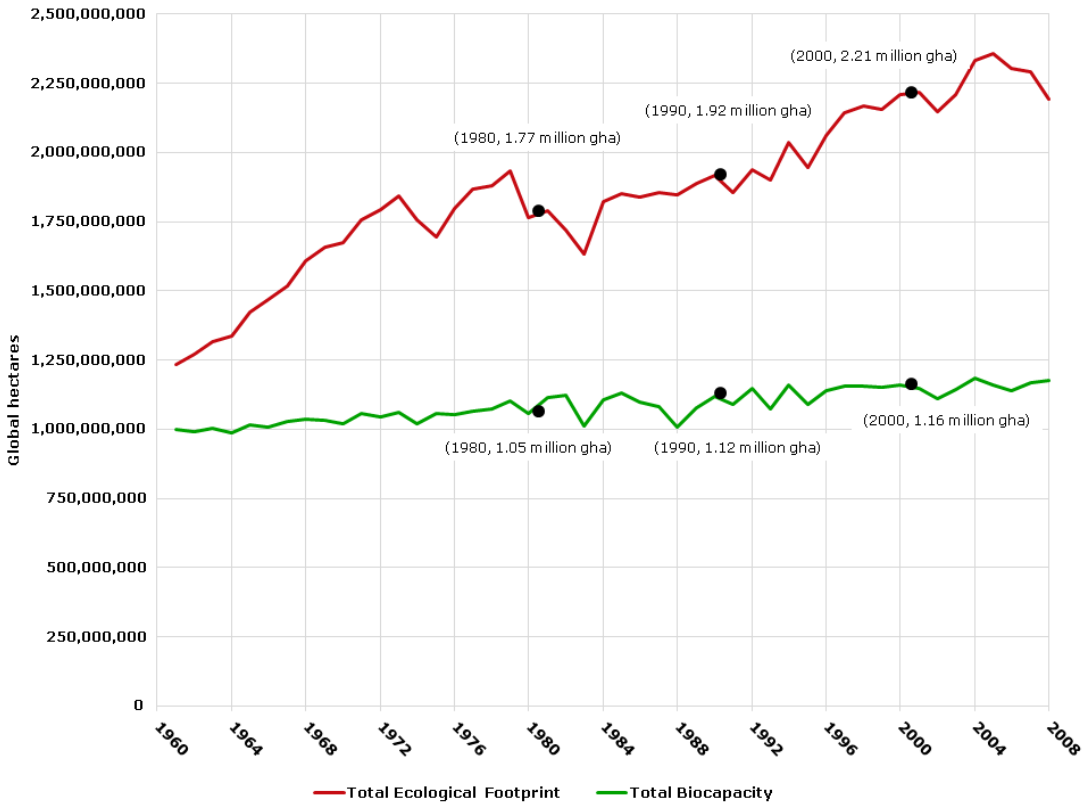

Figure 1 *The total Ecological Footprint and biocapacity of the United States, 1961– 2008.*

In other countries, population has an even larger effect on the total Ecological Footprint. In 2008, the most current year data are available, the total Footprint of the United States (2.2 billion gha) was second in size only to that of China (2.9 billion gha). But comparing the per capita Ecological Footprints in 2008, China's (2.1 gha per capita) is much smaller than that of the United States (7.2 gha per capita).

In 2008, the United States had the world's fifth largest per capita Ecological Footprint among countries with more than 1 million inhabitants, after Qatar (11.7 gha per person), Kuwait (9.7 gha per person), the United Arab Emirates (8.4 gha per person) and Denmark (8.3 gha per person).

Carbon remains the largest component of the United States' Ecological Footprint, accounting for 68 percent of the Ecological Footprint in 2008. The activities of consumers in the United States that contribute most to the carbon component of its Ecological Footprint are housing and transportation. Housing includes electricity, gas and other fuels, water supply, and maintenance and repairs; it accounts for 32 percent of the United States' carbon Footprint. Transportation includes purchase and operation of personal vehicles and public transportation services, accounting for another 24 percent of the United States' carbon Footprint.

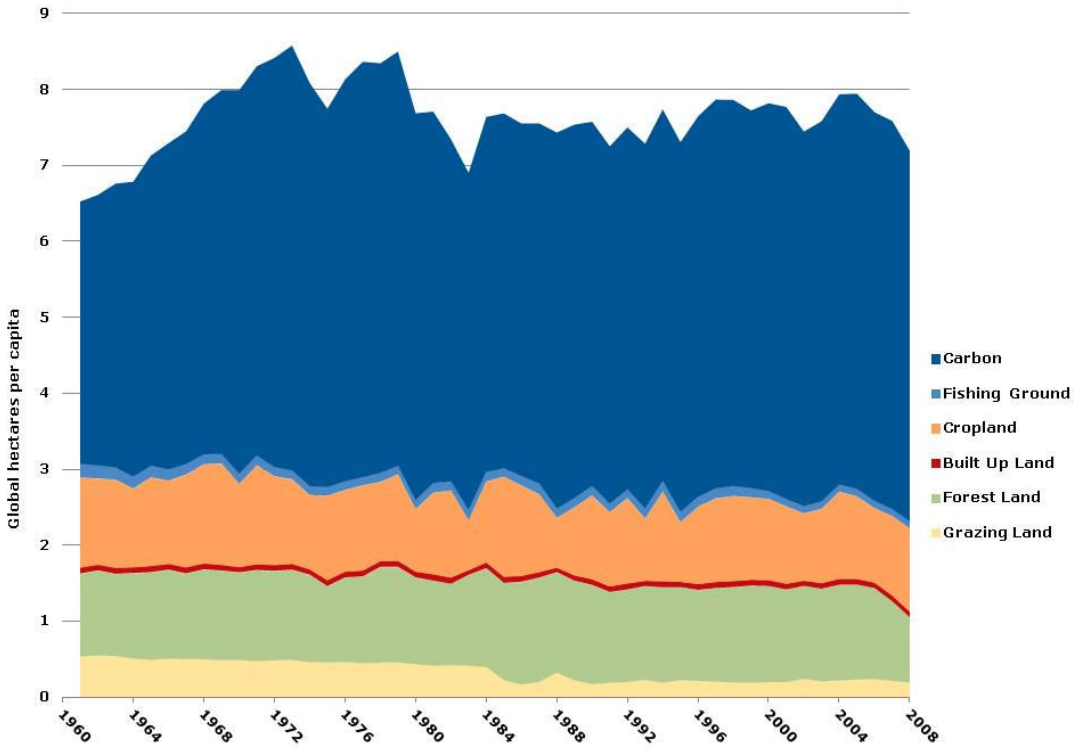

Figure 2 *The Ecological Footprint of the United States per land type, 1961 – 2008.*

California’s Ecological Footprint

The following results present the first year for which the Ecological Footprint and biocapacity of the state of California are calculated. This section gives a brief overview, then provides detail for each of the land types.

California's per capita Ecological Footprint is smaller than that of the United States

In 2008, California's per capita Ecological Footprint of 5.9 gha was smaller than that of the United States (7.2 gha per person). If California were a country, it would have the world's 15th largest per capita Ecological Footprint, between Ireland (6.2 gha) and Sweden (5.7 gha).

Most of the difference between the national Footprint average and California's is due to lower per capita carbon dioxide emissions in California. (The carbon component of California's Ecological Footprint is 4.3 gha per capita, which is 0.6 gha less than the United States' 4.9 gha average.) This difference can be traced to several factors: the mild climate in California that does not require as much heating and cooling[4]; the state's implementation of energy efficiency measures; and the use of hydropower in California. In addition, California does not use coal as much as other parts of the United States.

Table 1 *Per capita Ecological Footprints and biocapacities of California, the United States and the world in gha per capita, 2008.*

	California		United States		World	
Land type	Ecological Footprint	Biocapacity	Ecological Footprint	Biocapacity	Ecological Footprint	Biocapacity
Cropland	0.78	0.34	1.09	1.53	0.59	0.57
Grazing land	0.07	0.08	0.19	0.26	0.21	0.23
Fishing grounds	0.08	0.22	0.09	0.44	0.10	0.16
Forest product	0.59	0.27	0.86	1.56	0.26	0.76
Carbon Footprint	4.28		4.87		1.47	
Built-up land	0.12	0.12	0.07	0.07	0.06	0.06
TOTAL	5.92	1.02	7.19	3.86	2.70	1.78

[4] http://www.eia.gov/state/state-energy-profiles.cfm?sid=ca

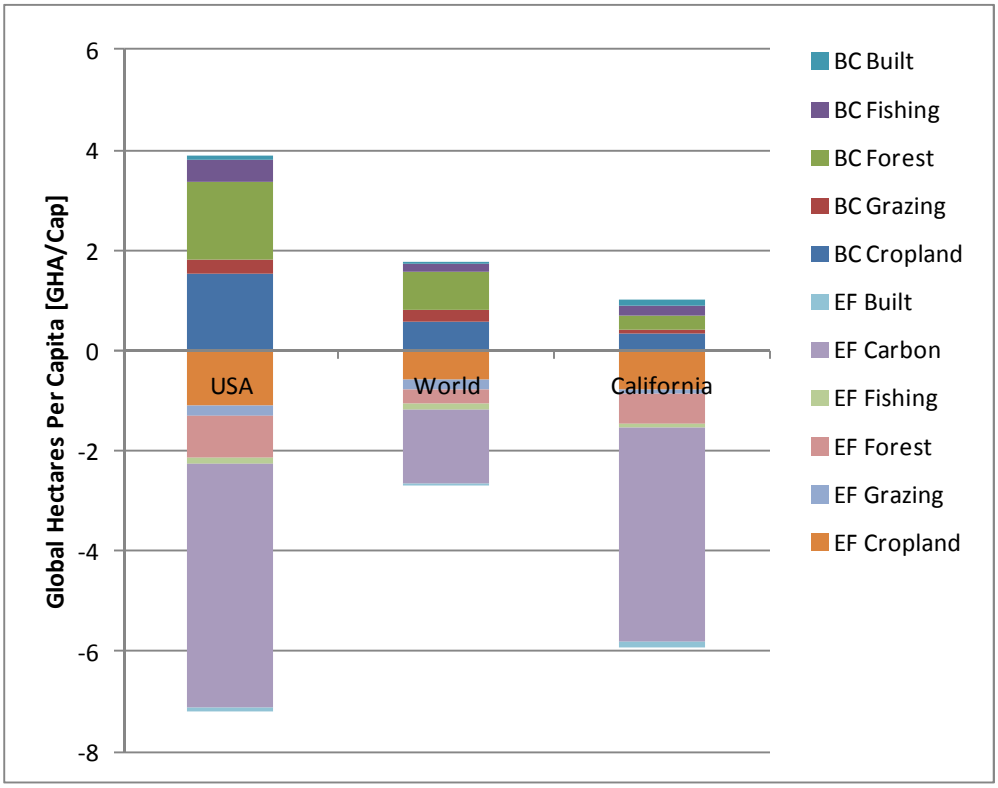

Figure 3 *The Ecological Footprints (downwards from zero) and biocapacity (upwards from zero) of the United States and California, per capita, 2008.*

California is running an ecological deficit overall

Although California's Ecological Footprint is less than the United States', California is still running an ecological deficit. In 2008, California's per capita biocapacity was 1.02 global hectares. This means that biocapacity in California was only able to support 17 percent of the population's Ecological Footprint. The remaining 83 percent was made up by importing biocapacity from elsewhere and releasing carbon dioxide emissions into the global atmosphere.

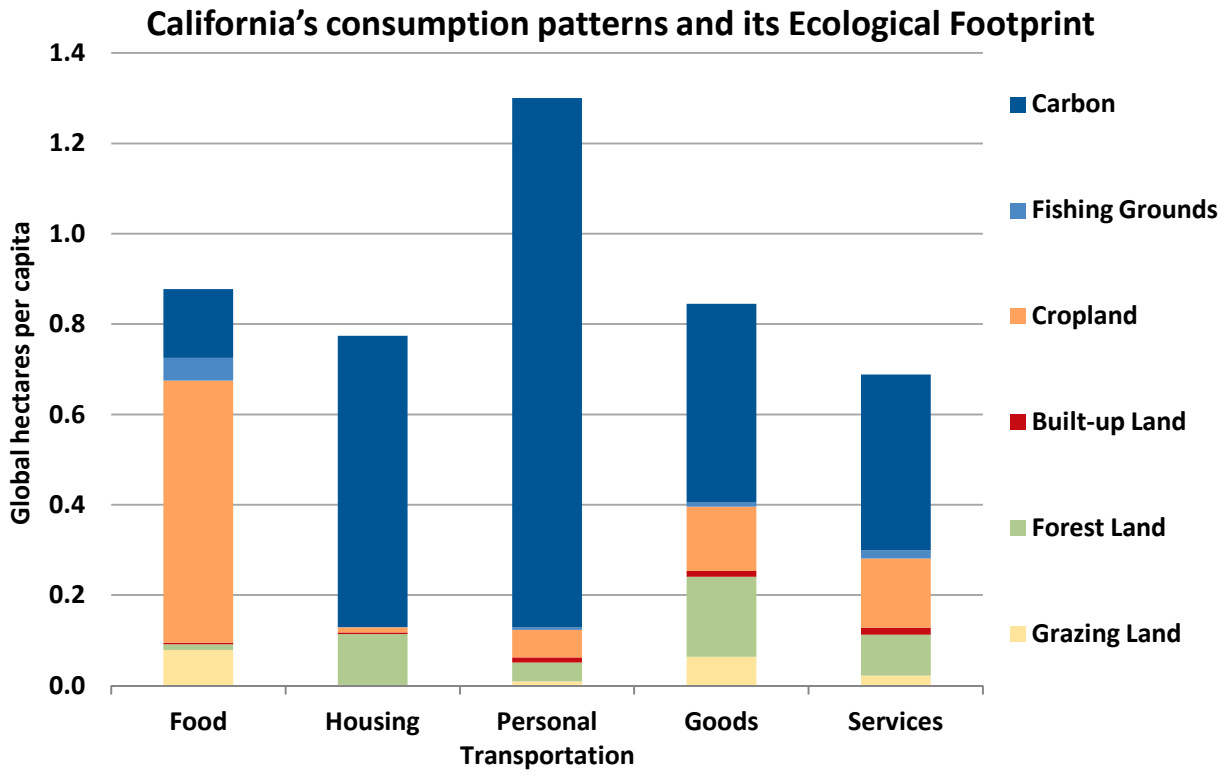

Figure 4 *California's Ecological Footprint of household consumption activity (limited to portion of short-lived goods and services directly paid for by household), 2008.*

The food Californians eat is what mainly drives the cropland, grazing land and fishing grounds components of the state's Ecological Footprint. Other consumption categories — housing, transportation, and goods and services — are the most significant factors in the forest product and carbon components.

The differences between what Californians consume and the amount of biocapacity available within the state vary among land types. Next, we examine California's Ecological Footprint and biocapacity by individual land type.

Cropland

California's cropland supports a significant portion of the population's diet and the state's economy. The cropland products that Californians consume account for 9 percent of the state's overall Ecological Footprint.

California's cropland biocapacity is surprisingly small

On the supply side, cropland biocapacity in California is significant because California generated $27.3 billion worth of agricultural output in 2008. This was 17 percent of the total agricultural economic output of the United States.

There are 173 million hectares of cropland in the United States, and California has just 3 million hectares, or 2 percent of the total cropland in the country. As a proportion of California's bioproductive land area, cropland only comprises 7 percent of California, while cropland is 12 percent of the total bioproductive land in the United States. However, crops grown in California have higher yields than the world and national averages, so proportionally less land is needed in California than in the United

States as a whole to produce the same amount of crops. Although the market value of crops produced in California is relatively high, biocapacity reflects biological productivity, not revenue.

In per capita terms, the cropland biocapacity for the United States was 1.5 gha, compared to 0.3 gha in California. This large difference is driven by a higher population density in California (0.9 people per hectare) compared to the United States (0.3 people per hectare). Future research is called for to focus on the other inputs and drivers of biocapacity, such as land area, agricultural water use, fossil fuel-based inputs and productivity.

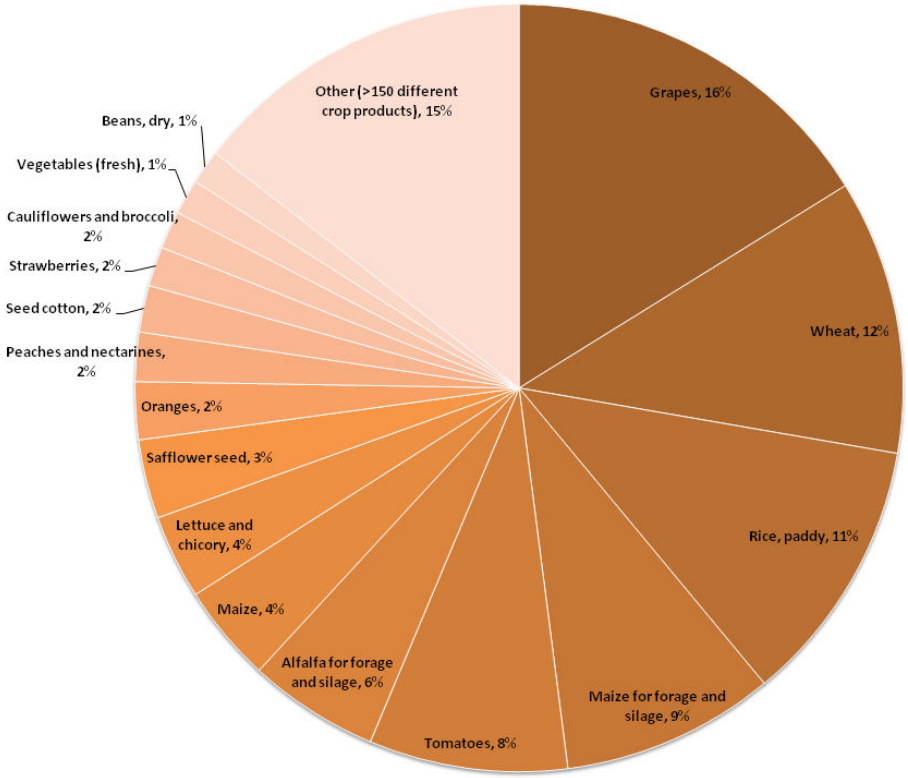

Figure 5 *California's cropland biocapacity by crop type. The percentages are based on total global hectares, 2008.*

Agriculture in California is different from the rest of the country in another significant way. Although proportionally less land in California is used to grow crops, a larger variety of crop products are grown. In 2008, three crop products contributed 39 percent of California's cropland biocapacity: grapes, wheat and rice paddy. Nationwide, the three largest crop products — corn, soybeans and wheat — made up 73 percent of total biocapacity; 38 percent of the country's cropland biocapacity was corn alone.

In 2008, cropland biocapacity in California was 12.4 million gha; 5.5 million gha of this biocapacity was embodied in exports. This means that California exported the equivalent of 44 percent of its cropland biocapacity.

To make up for low biocapacity, California relies on imports of crop products

In 2008, California's cropland Footprint of consumption (what the population consumes) was 157 million gha, which was much larger than cropland biocapacity that year (28.7 million gha). This gap between biocapacity and the Ecological Footprint was made up with imports, meaning Californians depended on cropland biocapacity from outside the state to support most of their food and fiber consumption.

Grazing land

Grazing land comprised only 1 percent of California's Ecological Footprint in 2008, compared to 3 percent nationally.

California's grazing land biocapacity is large enough to support its Footprint

The grazing land Footprint represents the amount of grassland required to support animals that are consumed by humans. In California, there is enough grazing land biocapacity to support the grass portion of livestock feed mixes for animals that produce the meat and dairy products Californians consume. In 2008, California's grazing land biocapacity was 2.8 million gha, which is greater than Californians' grazing land Footprint (2.6 million gha). The difference between grazing land biocapacity and Ecological Footprint indicates that California has an ecological reserve of grazing land.

California is a net exporter of products derived from livestock

The Footprint of production is the area necessary to support the actual harvest of primary products, reflecting the activities of the livestock and dairy sectors of California's economy. In other words, the Footprint of production does not account for the meat and dairy products consumed by Californians, just the animals raised on grazing land within the state. In California, 98 percent of grazing land used to support livestock production was for cattle and products derived from cattle; sheep and goats made up the remaining 2 percent. And although California imports some meat and dairy products, it exports more than it imports; net exports (exports - imports) were 250,000 gha in 2008 (equivalent to 9 percent of production).

However, not all livestock feed on grazing land. California livestock are fed a significant quantity of imported crop feed, and California is home to many intensive feedlot operations that rely on cropland rather than grazing land. Data limitations make it difficult to assess exactly how cropland, either from California or beyond, is consumed by feedlot operations. This would be a useful avenue for future research.

Fishing grounds

The big picture in the fishing grounds component of California's Ecological Footprint is tricky to pin down. Our calculations indicate there may be an **ecological reserve** in this category, meaning that available biocapacity may exceed the average Ecological Footprint of products from the ocean and inland waterways.

However, current data are inadequate to determine with certainty whether this is the case. In particular, the data informing the biocapacity analysis, and the complexity of trophic levels and collection of accurate production data, make the comparison of supply and demand in the fisheries component unreliable.

According to our calculations, California's total fishing grounds biocapacity in 2008 was 8.2 million global hectares, while the state's fishing grounds Footprint was 3.0 million global hectares. This does not mean that each individual marine species has a healthy population. Some species may be severely overfished and suffering from declining stocks, while others have a population large enough to sustain human demand.

California exports most of what is caught

However, looking at how this local biocapacity is used, we can evaluate the Footprint of production again, which for fishing grounds represents the area needed to grow all the fish caught off the coast of California and in the state's inland waterways. Fishing for squid (opalescent inshore squid or Loligo opalescens) made up half of California's fishing grounds Footprint of production in 2008. North Pacific hake (Merluccius productus) contributed another 18 percent to the fishing Footprint of production. These were also California's largest fish exports; these two species alone comprised 57 percent of the

fishing grounds Footprint of exports. Most of the fish caught in the state of California and off the coast were exported out of the state.

Californians import most of the fish products they consume

Net imports accounted for 75 percent of the fishing grounds Footprint of consumption. The embodied Footprint of fish products that California imports dwarfed the Footprint of production — imports were more than 4 times larger than production. California imported most of these products from the Asia-Pacific region, specifically Thailand, China, Indonesia, Vietnam and the Philippines; fish products from these countries made up 75 percent of the fishing grounds Footprint embodied in imports. Another 11 percent came from Latin American countries including Ecuador, Chile and Mexico.

Tuna products totaled half of the embodied Footprint of imports. The largest imports of tuna into California were from Thailand; other large suppliers were Ecuador, Fiji and the Philippines.

Forest product

California's forest product Footprint made up 10 percent of the state's Ecological Footprint in 2008. The state's forest product Footprint (21.8 million global hectares) that year exceeded its biocapacity (9.9 million gha), meaning California was running an ***ecological deficit*** in forestland, based on forest product demand alone. The second demand on forest biocapacity, carbon sequestration, is discussed in the carbon Footprint section below.

Harvest of timber products in California is lower than forest biocapacity, but the state still consumes more than is available

Timber in the amount equivalent to 2.2 million global hectares of biocapacity was harvested in 2008, much less than the state's 9.9 million global hectares of forest biocapacity. Nevertheless, most of the forest products that Californians consumed were imported into the state; net imports accounted for 90 percent of the forest product Footprint. Even if California used the entire 9.9 million global hectares of

forest biocapacity available within the state, half of the lumber, pulp and timber products Californians consumed would still have to be imported. And again, it must be noted that the additional demand on forests from CO_2 uptake would need to be accommodated by the 9.9 million global hectares of forest capacity if California were to provide all the ecological services its residents demand.

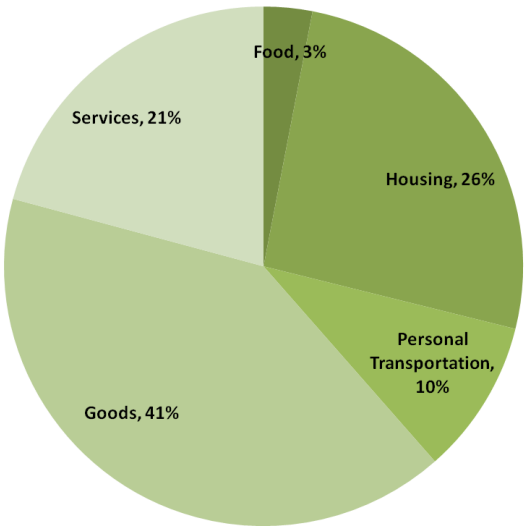

Figure 6 *The kinds of consumption that drive California's forest product Footprint, 2008.*

Unlike cropland, grazing land and fishing grounds Footprints, which are driven primarily by the food Californians eat, the forest product Footprint is primarily embodied in goods like recreational equipment, furniture, housing, paper, and tools and equipment for house maintenance and gardening.

Carbon Footprint

Carbon is the largest component of California's Ecological Footprint, accounting for 73 percent of the total. More than half of this component is from carbon dioxide emissions generated within the state; in 2008, direct emissions from activities in California equaled 90 million global hectares, which is 57 percent of the state's total carbon Footprint (157 million global hectares). The rest of the carbon Footprint is embodied in goods that are imported into the state — meaning that emissions were generated elsewhere to manufacture goods that are consumed in California.

The largest carbon component of California's Footprint is transportation

Transportation for people can be separated into two categories: personal transportation and public transportation. *Personal transportation* includes operation of personal transport equipment, such as cars, trucks and motorcycles. A separate category, "transport services," includes *public transportation* of passengers by railway, road, air and water.

The Footprint from transportation not only includes direct emissions from burning gas. It also accounts for embodied carbon, or the carbon dioxide emissions generated by the manufacture of spare parts and accessories, fuels and lubricants — all the goods and services for maintenance and repair. (The embodied carbon that goes into the original manufacture of cars is measured separately in the category called "purchase of vehicles.") Together, direct emissions and embodied emissions in personal and public transportation made up 24 percent of California's total Ecological Footprint in

2008. This was a larger portion than in the United States, where transportation (direct and embodied emissions, public and private vehicles) accounted for 17 percent.

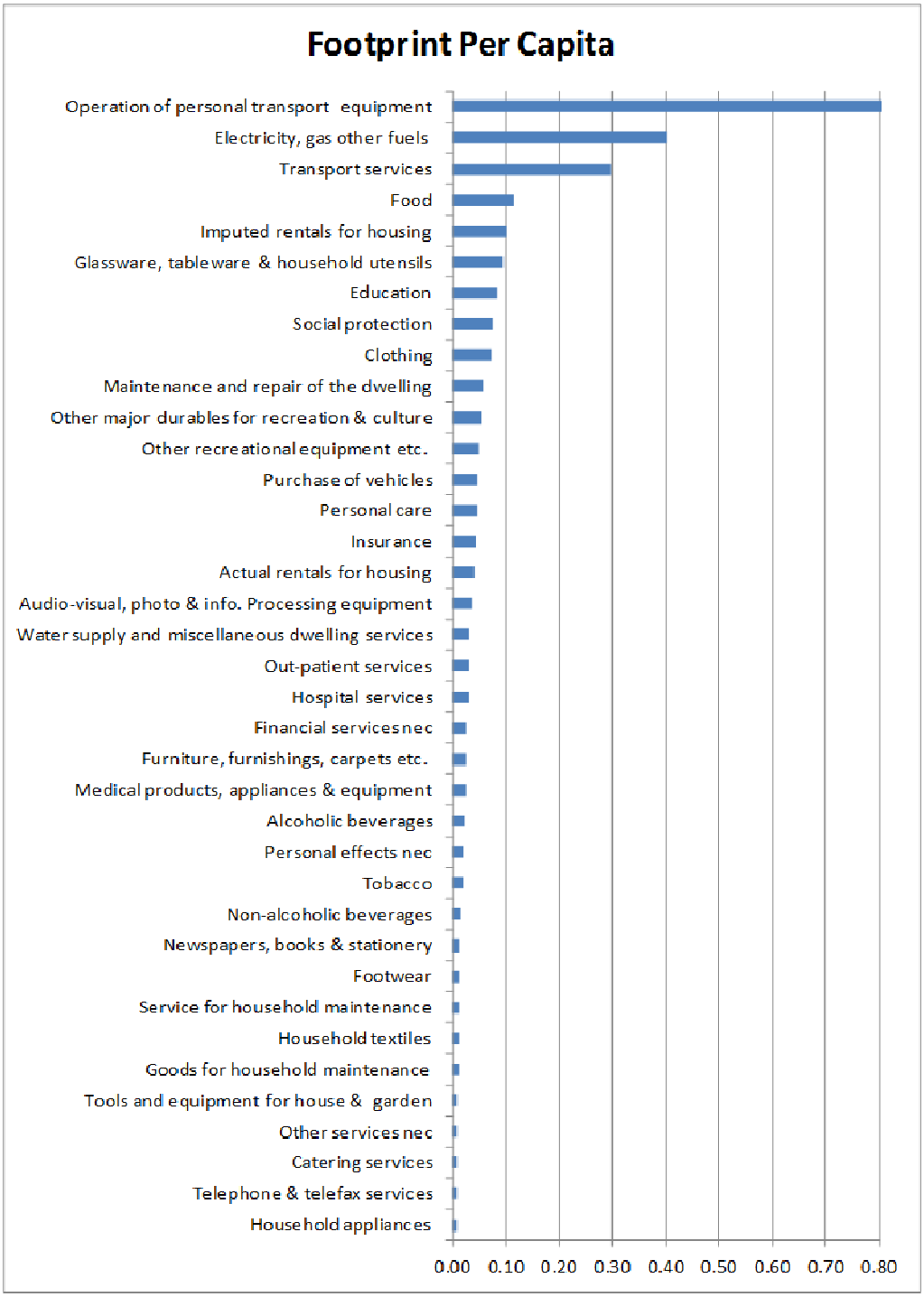

Figure 10 *Consumption activities that drive the carbon component of California's Ecological Footprint, 2008. This summary reflects the demand for goods and consumer activities that drive carbon emissions; it does not reflect the source of emissions.*

Electricity was the second-largest driver of the carbon component, accounting for 8 percent of California's carbon Footprint in 2008. Almost half of this electricity (49 percent) was imported from outside the state. For the United States as a whole, electricity was 22 percent of the carbon component of its Ecological Footprint.

As described above, there is no specific forest biocapacity associated with the carbon component of the Ecological Footprint — forest biocapacity is shared between CO_2 uptake and the forest product Footprint. Currently, carbon dioxide emissions are accumulating in the atmosphere at a rate faster than they can be sequestered by the planet's biocapacity; carbon dioxide emissions from fossil fuel burning are overloading global carbon sinks.

Globally, the carbon component of the world's Ecological Footprint has been the fastest-growing component since 1961, the earliest year for which data are available. In 2008, the carbon component of the world's Ecological Footprint (all countries combined) was 9.9 billion global hectares. To this, California contributed 0.16 billion global hectares, or 2 percent of the global total, while the population of California made up 0.6 percent of the global population.

How the carbon component of the Ecological Footprint relates to forest biocapacity

All components of the Ecological Footprint represent demands on ecosystem services that compete for space. In the case of potatoes and carrots, that includes the crop area needed to grow them, plus the area required for other agricultural inputs and the harvest, processing and distribution of the crops. In the case of using fossil fuel, a number of ecological services are required, from mining to use. The largest need is for waste sinks for the carbon emissions that result from burning fossil fuel.

This demand on ecosystems can be quite distant in space and time from the site of emission. But it is real demand nevertheless. Without that service, an ecological debt builds up. It manifests as an increasing carbon concentration in the atmosphere. Current national Footprint calculations (and the one presented here for California) are limited to the carbon emission of fossil fuel burning, as it is the most dominant demand on nature when using fossil fuel. More complete data sets would allow us to include a larger array of demands on nature imposed by the use of fossil fuels.

As described earlier, the carbon component of the Ecological Footprint is calculated as the amount of forest area required to sequester carbon dioxide emissions from fossil fuel burning, after subtracting what is absorbed by the oceans. The underlying assumption is that all released carbon dioxide emissions that are not absorbed by the oceans add to the carbon debt in the atmosphere. To

neutralize this debt, the extra carbon needs to be sequestered by vegetation. We assume that this vegetation would be forests.

Applying this assumption globally, in 2008 there were 5.1 billion global hectares of forest biocapacity available. Of this, 1.8 billion global hectares were used to support the global forest product Footprint, leaving 3.3 billion global hectares potentially available to sequester carbon. However, the carbon component of the global Ecological Footprint totaled 10 billion global hectares, meaning that there was only enough growth in forestland worldwide to sequester 33 percent of global carbon dioxide emissions.

As discussed above in the forest section, California had approximately 9.9 million global hectares of domestic forest biocapacity in 2008, and its total forest product Footprint was 21.8 million global hectares, much of that coming from imports. The two demands on forests combined, forest products and carbon Footprint, far exceed California's forest biocapacity.

It might be tempting to assume that simply showing a reserve of forest biocapacity under our methodology would translate into direct mitigation of some of the carbon Footprint. However, without a firm legal commitment to keeping this portion of the forest dedicated to carbon sequestration, it cannot be considered a lasting carbon sink.

The Ecological Footprint methodology assumes that biocapacity provides a number of services: provision of renewable resources, provision of space for infrastructure, and sequestration of emitted waste such as carbon dioxide from fossil fuel burning. While forests provide both resource provision services (lumber, fiber, fuel, etc.) and waste absorption (forests are the dominant land type for carbon sequestration), there are no clear data on how much forestland is committed to long-term carbon sequestration. Without globally consistent data, by country, showing the amount of forestland set aside for carbon sequestration versus the amount of forestland from which wood products are harvested, Ecological Footprint and biocapacity values of both forest products and carbon emissions must be compared against forest biocapacity as a whole.

The usefulness of considering carbon dioxide as a component of the Ecological Footprint is to place carbon dioxide emissions within the context of ecosystem services: Carbon dioxide emissions place pressure on ecosystems globally. Not sequestering all the emitted CO_2 in a given year means leaving a carbon debt for the future in the form of higher carbon concentration in the atmosphere. Such overuse due to carbon emissions is similar to leaving a forest debt when harvesting more timber from a forest than is being renewed.

California's biocapacity

Biocapacity is the capacity of ecosystems to produce useful biological materials and to absorb waste materials generated by humans, using current management schemes and technologies. It is a measure of how quickly renewable biological resources can be regenerated from the area of land available. It works like the interest rate on a bank account: The principal amount in the account generates additional money every year, and expenditures (Ecological Footprint) that exceed the interest rate (biocapacity) deplete the principal.

If California were a country, it would have the world's 138th largest per capita biocapacity and the 55th largest total biocapacity out of 150 countries. In 2008, the largest portion of California's biocapacity was in cropland, followed by forestland and fishing grounds.

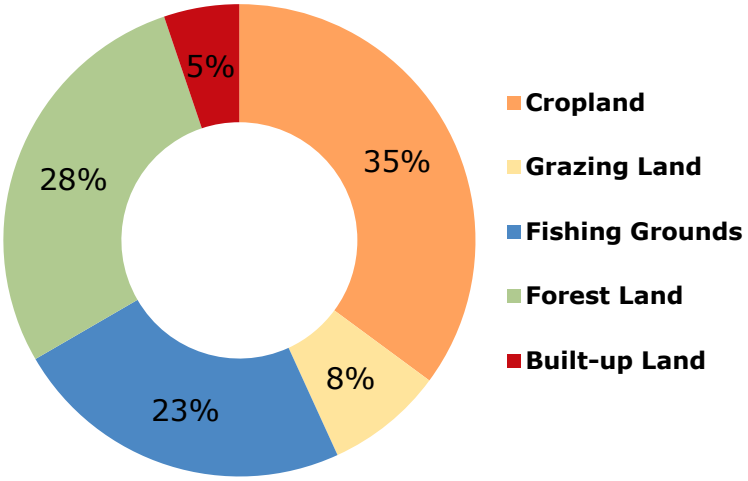

Figure 7 *California's biocapacity by land type, 2008.*

The productivity of land areas, and thus biocapacity, is influenced by a number of inputs, including water, land area, sun, soil and fossil fuels. In California, one of the main limiting factors is water. Although the Ecological Footprint and biocapacity calculations do not directly include water use or water availability, water resources are intrinsic to biocapacity. Lack of water or polluted water has a direct impact on the availability and yields of productive areas; without enough water, California will have less biocapacity.

Because water is a critical production factor for biocapacity, managing water resources is of central concern for any policy in the state, whether social, economic or environmental. And robust monitoring is important. Key measures include surface water and groundwater indicators from the Gravity Recovery and Climate Experiment (GRACE).

Energy is used not only to harvest, process and distribute California's biocapacity, but also to transport California's water resources. Reliance on fossil fuels is another important limiting factor that, like water, is not directly included in biocapacity calculations. However, the risks associated with use of fossil fuel are similar to the risks associated with water: As the supply is depleted and/or the price of oil increases, access to biocapacity will be limited.

California is already running an ecological deficit. As the competition for global resources increases, it will become more difficult to obtain the primary inputs to California's biocapacity, such as water and oil, as well as the products Californians demand. With continuous monitoring of California's Ecological Footprint and biocapacity, including the water resources that underpin biocapacity, critical relationships between resource availability and economic success in California can be identified. Such monitoring can help identify how far and how fast we need to go to avoid depleting our ecological assets — not just to avoid loss of biodiversity, but to feed the economy.

Future Developments

Several additional research avenues could strengthen the detailed data provided by this analysis of Ecological Footprint and biocapacity for California.

One important area of research would be to examine the policy options available to address the largest components of California's Ecological Footprint, particularly carbon. This would need to take into account the detailed breakdown of highest-carbon consumption activities in Figure 10, as well as the context of existing greenhouse gas reduction efforts such as AB 32, the Global Warming Solutions Act of 2006.

Similarly, it would be useful to investigate strategies to increase California's available biocapacity, especially on a per capita basis and given expected increases in population.

Higher-resolution data are needed to assess in more detail the components of livestock operations and grazing land Footprint. Although cattle are the largest consumers of grazing land by far, a full chart of grazing land consumption by animal is not possible given current data, nor can comparisons be made to determine, for example, the relative Footprint efficiency of grazing land consumption across various livestock species. As discussed above, research into the domestic and imported cropland consumption by large feedlot operations would also be valuable.

A complementary analysis of water availability and consumption would be helpful. In particular, isolating water's relationship to changes in cropland Footprint and biocapacity would help to link the impact of another valuable resource to those covered in this report.

Lastly, further research is also needed into the health of individual marine species with respect to their share of the fishing grounds biocapacity and Footprint. While methodologically challenging, this work would help us understand what fraction of the fishing grounds Footprint and biocapacity stable or growing populations occupy, and also what fractions of current consumption and availability are linked to species at the greatest risk of collapse. Furthermore, it would be useful to understand these issues in the context of fish imports and exports: How does the long-term viability of fish and other marine populations differ in terms of what Californians produce and what they consume?

APPENDIX A: FAQ

How is the Ecological Footprint calculated?

The Ecological Footprint measures the amount of biologically productive land and water area required to produce the resources an individual, population or activity consumes and to absorb their emitted waste, given prevailing technology and resource management. On the waste side, current National Footprint Accounts only include carbon dioxide from fossil fuel burning. The Footprint and the biocapacity areas are expressed in global hectares (biologically active hectares with world average biological productivity). To express results in global hectares, Footprint calculations use yield factors to normalize countries' biological productivity to world averages (e.g., comparing tonnes of wheat per U.K. hectare to the corresponding world average) and equivalence factors to take into account differences in world average productivity among area types (e.g., world average forest versus world average cropland).

Footprint and biocapacity results for countries are calculated annually by Global Footprint Network, based on United Nations statistics. Collaborations with national governments are invited, and serve to improve the data and methodology used for the National Footprint Accounts. To date, Switzerland has completed a review, and Belgium, Ecuador, Finland, Germany, Ireland, Japan and the United Arab Emirates have partially reviewed or are reviewing their accounts. See examples at www.footprintnetwork.org/reviews. The continuing methodological development of the National Footprint Accounts is overseen by a formal review committee. A detailed methods paper and copies of sample calculation sheets can be obtained from www.footprintnetwork.org.

Footprint analyses can be conducted at any scale. There is growing recognition of the need to standardize subnational Footprint applications in order to increase comparability across studies and over time. Methods and approaches for calculating the Footprint of municipalities, organizations and products are currently being aligned through a global Ecological Footprint standards initiative. Two editions of standards have already been issued, the initial in 2006 and a second edition in 2009. For more information on Ecological Footprint standards see www.footprintstandards.org.

What is included in the Ecological Footprint? What is excluded?

To avoid exaggerating human demand on nature, the Ecological Footprint includes only those aspects of resource consumption and waste production for which the Earth has regenerative capacity, and where data exist that allow this demand to be expressed in terms of productive area. For example, toxic releases are not accounted for in Ecological Footprint accounts. Freshwater withdrawals also are not included, although carbon dioxide emissions associated with the energy used to pump or treat water are.

Also, demands on biocapacity are only included in so far as they exclude each other. In other words, demands that can be accommodated by the same surface area are only counted as one demand in order not to double-count the same surface.

Ecological Footprint accounts provide snapshots of past resource demand and availability. They do not predict the future. Thus, while the Footprint does not estimate future losses caused by current degradation of ecosystems, if this degradation persists, it may be reflected in future accounts as a reduction in biocapacity.

Footprint accounts do not indicate the intensity with which a biologically productive area is being used. And, being a biophysical measure, the Ecological Footprint does not evaluate other essential social and economic dimensions of sustainability.

How is international trade taken into account?

The National Footprint Accounts calculate the Ecological Footprint associated with each country's total consumption by summing the Footprint of its imports and its production, and subtracting the Footprint of its exports. This means that the resource use and emissions associated with producing a car that is manufactured in Japan, but sold and used in India, will contribute to India's rather than Japan's consumption Footprint.

National consumption Footprints can be distorted when the resources used and waste generated in making products for export are not fully documented for every country. Inaccuracies in reported trade can significantly affect the Footprint estimates for countries where trade flows are large relative to total consumption. However, this does not affect the total global Footprint.

How does the Ecological Footprint account for the use of fossil fuels?

Fossil fuels such as coal, oil and natural gas are extracted from the Earth's crust and are not renewable in ecological time spans. When these fuels burn, carbon dioxide (CO_2) is emitted into the atmosphere. There are two ways in which this CO_2 can be stored: human technological sequestration of these emissions, such as deep-well injection, or natural sequestration. Natural sequestration occurs when ecosystems absorb CO_2 and store it either in standing biomass, such as trees, or in soil.

Carbon sequestration land is calculated by estimating how much natural sequestration would be necessary to maintain a constant concentration of CO_2 in the atmosphere. After subtracting the amount of CO_2 absorbed by the oceans, Ecological Footprint accounts calculate the area required to absorb and retain the remaining carbon based on the average sequestration rate of the world's forests. CO_2 sequestered by artificial means would also be subtracted from the Ecological Footprint total, but at present this quantity is negligible. In 2008, 1 global hectare could absorb the CO_2 released by burning approximately 1,450 liters of gasoline.

Expressing CO_2 emissions in terms of an equivalent bioproductive area does not imply that carbon sequestration in biomass is the key to resolving global climate change. On the contrary, it shows that the biosphere has insufficient capacity to offset current rates of anthropogenic CO_2 emissions. The contribution of CO_2 emissions to the total Ecological Footprint is based on an estimate of world average forest yields. This sequestration capacity may change over time. As forests mature, their CO_2 sequestration rates tend to decline. If these forests are degraded or cleared, they may become net emitters of CO_2.

Carbon emissions from some sources other than fossil fuel combustion are incorporated in the National Footprint Accounts at the global level. These include fugitive emissions from the flaring of gas in oil and natural gas extraction, carbon released by chemical reactions in cement production, and emissions from tropical forest clearing.

How does the Ecological Footprint account for carbon emissions absorbed by the oceans versus uptake by forests?

The National Footprint Accounts calculate the carbon Footprint by considering sequestration by the world's oceans and forests. Annual ocean uptake values are taken from Khatiwala (Khatiwala et al., 2009[5]) and used with the anthropogenic carbon emissions taken from the U.S. Department of Energy's Carbon Dioxide Information Analysis Center (CDIAC, 2011). There is a relatively constant percentage uptake for oceans, varying between 28 and 35 percent over the period 1961-2008. The remaining CO_2 requires land-based sequestration. Due to the limited availability of large-scale data sets, the calculation currently assumes the world average sequestration rate for uptake of carbon dioxide into forests. Therefore, the carbon Footprint is a measure of the area of world average forestland necessary to sequester the carbon dioxide emissions not absorbed into the world's oceans.

Does the Ecological Footprint take into account wild species?

The Ecological Footprint compares human demand on biocapacity with the natural world's capacity to meet this demand. It thus serves as an indicator of human pressure on local and global ecosystems. In 2008, humanity's demand exceeded the biosphere's regeneration rate by more than 50 percent. This overshoot may result in depletion of ecosystems and fill-up of waste sinks, contributing to ecosystem stresses that may negatively impact biodiversity. However, the Footprint does not measure the latter impact directly, nor does it specify how much overshoot must be reduced if negative impacts on biodiversity are to be avoided.

[5] Khatiwala, S. et al., 2009. Reconstruction of the history of anthropogenic CO_2 concentrations in the ocean. *Nature* 462, 346-350

Does the Ecological Footprint say what is a "fair" or "equitable" use of resources?

The Footprint documents what has happened in the past. It can quantitatively describe the ecological resources used by an individual or a population, but it does not prescribe what that individual or population "should" be using. Resource allocation is a policy issue, based on societal beliefs about what is or is not equitable. While Footprint accounting can determine the average biocapacity that is available per person, it does not stipulate how this biocapacity should be allocated among individuals or countries. The Ecological Footprint does, however, provide a context for such discussions.

How relevant is the Ecological Footprint if the supply of renewable resources can be increased and advances in technology can slow the depletion of nonrenewable resources?

The Ecological Footprint measures the current state of resource use and carbon dioxide waste generation. It asks: In a given year, did human demands on ecosystems exceed the ability of ecosystems to meet these demands? Footprint analysis reflects both increases in the productivity of renewable resources and technological innovation. (For example, if the paper industry doubles the overall efficiency of paper production, the Footprint per tonne of paper will halve.) Ecological Footprint accounting captures these changes once they occur and can determine the extent to which these innovations have succeeded in bringing human demand within the capacity of the planet's ecosystems. If there is a sufficient increase in ecological supply and a reduction in human demand due to technological advances or other factors, Footprint Accounts will show this as the elimination of global overshoot.

For additional information about current Ecological Footprint methodology, data sources, assumptions and results, please visit: www.footprintnetwork.org/atlas. For further information on the methodology used to calculate the Ecological Footprint, please see Borucke et al., 2013[6].

[6] Borucke, M., Moore, D., Cranston, G., Gracey K., Iha, K., Larson, J., Lazarus, E., Morales, JC, Wackernagel, M., Galli, A. 2013, Accounting for demand and supply of the Biosphere's regenerative capacity: the National Footprint Accounts' underlying methodology and framework. *Ecological Indicators*.

APPENDIX B: Glossary

Biological capacity (or biocapacity): The capacity of ecosystems to produce useful biological materials and to absorb waste materials generated by humans, using current management schemes and technologies. "Useful biological materials" are defined as those used by the human economy. Hence what is considered "useful" can change from year to year. (For example, the use of corn/maize stover for cellulosic ethanol production would result in corn stover becoming a useful material, increasing the total yields and thus the biocapacity of maize cropland.) The biocapacity of an area is calculated by multiplying the actual physical area by the yield factor and the appropriate equivalence factor. Biocapacity is usually expressed in global hectares.

Biologically productive land and water: The land and water (both marine and inland waters) area that supports significant photosynthetic activity and the accumulation of biomass used by humans. Nonproductive areas, as well as marginal areas with patchy vegetation, are not included. Biomass that is not of use to humans is also not included. The total biologically productive area on land and water in 2008 was approximately 12 billion global hectares.

Carbon Footprint: When used in Ecological Footprint studies, this term is synonymous with demand on CO_2 area. The phrase "carbon footprint" has been picked up in the climate change debate, and there are Web-based calculators to measure what is termed "carbon footprint." Many of these simply calculate tonnes of carbon, or tonnes of carbon per unit of currency, rather than the demand on bioproductive area. The Ecological Footprint encompasses the carbon Footprint, and also captures the extent to which measures for reducing the carbon Footprint lead to changes in other Footprint components.

Consumption: The term consumption has various meanings, depending on the context. As commonly used in regard to the Footprint, it refers to the use of goods or services. A consumed good or service embodies all the resources, including energy, necessary to provide it to the consumer. In full life-cycle accounting, everything used along the production chain is taken into account, including any losses along the way. For example, consumed food includes not only the plant or animal matter people eat and waste in the household, but also that lost during processing or harvest, as well as all the energy used to grow, harvest, process and transport the food.

As used in Input-Output analysis (a methodology often used in Footprint studies), consumption has a strict technical meaning. Two types of consumption are distinguished: intermediate and final. According to the (economic) System of National Accounts terminology, intermediate consumption refers to the use of goods and services by a business in providing goods and services to other businesses. Final consumption refers to nonproductive use of goods and services by households, the government, the capital sector and foreign entities.

Derived product: The product resulting from the processing of a primary product. For example, wood pulp, a secondary product, is a derived product of roundwood. Similarly, paper is a derived product of wood pulp.

Ecological deficit/reserve (or biocapacity deficit/reserve): The difference between the biocapacity and Ecological Footprint of a region or country. An ecological deficit occurs when the Footprint of a population exceeds the biocapacity of the area available to that population. Conversely, an ecological reserve exists when the biocapacity of a region or country exceeds the Footprint of its population. If there is a regional or national ecological deficit, it means that the region or country is either importing embedded biocapacity through trade, liquidating its own ecological assets, or emitting carbon dioxide waste into a global commons such as the atmosphere. In contrast to ecological deficits at the national scale, the global ecological deficit cannot be compensated for through trade, and is therefore overshoot by definition.

Ecological Footprint: A measure of how much biologically productive land and water an individual, population or activity requires to produce all the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management practices. The Ecological Footprint is usually measured in global hectares. Because trade is global, an individual or country's Footprint can include land or sea from all over in the world. Ecological Footprint is often referred to in short form as Footprint. Because "Ecological Footprint" and "Footprint" are proper nouns, they are capitalized (as opposed to a foot's footprint, as in a human footprint in the sand).

Ecological Footprint Standards: Specified criteria governing methods, procedures, data sources and reporting to be used in Footprint studies. Standards are established by the Global Footprint Network Standards Committees, composed of scientists and Footprint practitioners from around the world. Standards serve to produce transparent, reliable and mutually comparable results in studies done throughout the Footprint community. Where Standards are not appropriate, Footprint Guidelines should be consulted. For more information, consult www.footprintstandards.org.

Embodied energy: Embodied energy is the energy used during a product's entire life cycle in order to manufacture, transport, use and dispose of the product. Footprint studies often use embodied energy when tracking the trade of goods.

Footprint of consumption: The most commonly reported type of Ecological Footprint; it is defined as the area used to support a specific population's consumption. The Footprint of consumption (in global hectares) includes the area needed to produce the materials consumed and the area needed to absorb the carbon dioxide waste associated with that consumption. The Footprint of consumption of a nation is calculated in the National Footprint Accounts as a nation's Footprint of production plus the Footprint of imports minus the Footprint of exports, and is thus, strictly speaking, a Footprint of

apparent consumption. The national average or per capita Footprint of consumption is equal to a country's Footprint of consumption divided by its population.

Footprint of production: In contrast to the Footprint of consumption, the Footprint of production is the sum of the Footprints for all resources harvested and all carbon dioxide waste generated within the defined geographical region. This includes all area (cropland, pasture land, forestland and fishing grounds) necessary for supporting the actual harvest of primary products, food, fiber and timber, as well as the region's built-up area (roads, factories, cities), and the area needed to absorb all fossil fuel carbon emissions generated within the region. In other words, the forest Footprint represents the area necessary to regenerate all the timber harvested. And hence, depending on harvest rates, this area can be bigger or smaller than the forest area that exists within the region. Moreover, if cotton is grown for export, the productive area required is not included in that population's Footprint of consumption; rather, it is included in the Footprint of consumption of the population that imports the T-shirts. However, this productive area is included in the exporting region's Footprint of production.

Global hectare (gha): A productivity-weighted area used to report both the biocapacity of the Earth, and the demand on biocapacity (the Ecological Footprint). The global hectare is normalized to the area-weighted average productivity of biologically productive land and water in a given year. Productivity varies greatly among land types. So, for example, 1 global hectare of cropland would occupy a smaller physical area than 1 global hectare of pasture land, which is much less biologically productive. Conversely, a larger physical area in pasture land would be needed to provide the same biocapacity as physical cropland. Because world bioproductivity varies slightly over time, the value of a global hectare may change a bit from year to year.

National Footprint Accounts: The central data set of the Footprints and biocapacities of the world and roughly 220 nations from 1961 to the present (generally with a three-year lag due to data availability). The ongoing development, maintenance and upgrades of the National Footprint Accounts are coordinated by Global Footprint Network and its 80-plus partners.

Primary product: In Footprint studies, a primary product is the least-processed form of a biological material that humans harvest for use. There is a difference between the raw product, which is all the biomass produced in a given area, and the primary product, which is the biological material humans will harvest and use. For example, a fallen tree is a raw product that, when stripped of its leaves and bark, results in the primary product of roundwood. Primary products are then processed to produce secondary products like wood pulp and paper. Other examples of primary products are potatoes,

cereals, cotton, and types of forage. Examples of secondary products are kilowatt-hours of electricity, bread, clothes, beef and appliances.[7]

Productivity: The amount of biological material useful to humans that is generated in a given area. In agriculture, productivity is called yield.

Yield: The amount of primary product, usually reported in tonnes per year, that humans extract per area unit of biologically productive land or water.

[7] Note: Primary product is a Footprint-specific term. It is not related to, and should not be confused with, the ecological concepts of primary production, gross primary productivity (GPP) and net primary productivity (NPP).

APPENDIX C: Data tables

The Ecological Footprint and biocapacity analysis for the state of California is described in technical detail in a separate report, "Methodology for calculating the Ecological Footprint of California."[8] The purpose of this report is to present the results of this analysis in a manner accessible to a wide audience of decision-makers, stakeholders and other interested parties.

The first two tables below show the results of the Ecological Footprint and biocapacity analysis as totals (Table 2) and in per capita terms (Table 3). Table 4 shows the portion of the Ecological Footprint that can be accounted for by household consumption (e.g., not including consumption paid for by government or investments in Gross Fixed Capital that are not immediately consumed); these data are summarized by consumption category based on the Classification of Individual Consumption according to Purpose[9] used by the United Nations Statistics Division.

[8] Moore, D., Larson, J., Iha, K., 2012. Methodology for calculating the Ecological Footprint of California. Global Footprint Network, Oakland, USA. Report prepared for EPA Region 9. Unpublished document.

[9] http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=5

Table 1. *California's total Ecological Footprint and biocapacity* (total gha) *2008.*

	Cropland	Grazing land	Fishing grounds	Forest products	Carbon Footprint	Built-up land	TOTAL
Footprint of production	12,361,631	2,836,741	744,853	2,242,887	89,549,955	4,259,005	111,995,071
Footprint of imports	21,794,378	565,941	3,040,178	20,268,991	103,474,631	-	149,144,119
Footprint of exports	5,484,998	815,902	794,485	695,295	35,765,348	-	43,556,028
Footprint of consumption	28,671,012	2,586,780	2,990,545	21,816,583	157,259,238	4,259,005	217,583,163
Biocapacity	12,361,631	2,836,741	8,246,214	9,933,040	-	4,259,005	37,636,630

Table 2. *California's per capita Ecological Footprint and biocapacity (gha per capita), 2008.*

	Cropland	Grazing land	Fishing grounds	Forest products	Carbon Footprint	Built-up land	TOTAL
Footprint of production	0.34	0.08	0.02	0.06	2.44	0.12	3.05
Footprint of imports	0.59	0.02	0.08	0.55	2.82	-	4.06
Footprint of exports	0.15	0.02	0.02	0.02	0.97	-	1.18
Footprint of consumption	0.78	0.07	0.08	0.59	4.28	0.12	5.92
Biocapacity	0.34	0.08	0.22	0.27	-	0.12	1.02

Table 4. *California's per capita household Ecological Footprint by consumption category (excluding Gross Fixed Capital expenditures and consumption paid for by government), 2008.*

Consumption category	Cropland	Grazing land	Forest products	Fishing grounds	Built-up land	Carbon Footprint	TOTAL
Food	0.58	0.08	0.01	0.05	0.00	0.15	0.88
Food	0.48	0.06	0.01	0.04	0.00	0.12	0.71
Non-alcoholic beverages	0.04	0.01	0.00	0.00	0.00	0.01	0.06
Alcoholic beverages	0.06	0.01	0.00	0.01	0.00	0.02	0.11
Housing	0.01	0.00	0.11	0.00	0.00	0.64	0.77
Actual rentals for housing	0.00	0.00	0.00	0.00	0.00	0.04	0.04
Imputed rentals for housing	0.00	0.00	0.00	0.00	0.00	0.10	0.11
Maintenance and repair of the dwelling	0.00	0.00	0.09	0.00	0.00	0.06	0.16
Water supply and miscellaneous dwelling services	0.00	0.00	0.00	0.00	0.00	0.03	0.04
Electricity, gas, other fuels	0.00	0.00	0.01	0.00	0.00	0.40	0.41
Service for household maintenance	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Personal transportation	0.06	0.01	0.04	0.01	0.01	1.17	1.30
Purchase of vehicles	0.01	0.00	0.01	0.00	0.00	0.05	0.07
Operation of personal transport equipment	0.05	0.01	0.03	0.01	0.01	0.83	0.92
Transport services	0.00	0.00	0.00	0.00	0.00	0.30	0.30
Goods	0.14	0.06	0.18	0.01	0.01	0.44	0.84
Clothing	0.04	0.03	0.01	0.00	0.00	0.07	0.16
Footwear	0.01	0.00	0.00	0.00	0.00	0.01	0.02
Furniture, furnishings, carpets, etc.	0.01	0.01	0.01	0.00	0.00	0.03	0.05
Household textiles	0.01	0.00	0.00	0.00	0.00	0.01	0.02
Household appliances	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Glassware, tableware & household utensils	0.00	0.00	0.00	0.00	0.00	0.10	0.10
Tools and equipment for house & garden	0.00	0.00	0.02	0.00	0.00	0.01	0.03
Medical products, appliances & equipment	0.00	0.00	0.00	0.00	0.00	0.02	0.03
Telephone & telefax equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Audio-visual, photo & info. processing equipment	0.00	0.00	0.01	0.00	0.00	0.04	0.05
Other major durables for recreation & culture	0.00	0.00	0.00	0.00	0.00	0.05	0.06
Other recreational equipment, etc.	0.02	0.01	0.11	0.00	0.00	0.05	0.19
Newspapers, books & stationery	0.00	0.00	0.01	0.00	0.00	0.01	0.02
Goods for household maintenance	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Tobacco	0.05	0.01	0.00	0.00	0.00	0.02	0.09
Services	0.15	0.02	0.09	0.02	0.02	0.39	0.69
Outpatient services	0.00	0.00	0.00	0.00	0.00	0.03	0.04
Hospital services	0.00	0.00	0.00	0.00	0.00	0.03	0.04
Postal services	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Telephone & telefax services	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Recreational & cultural services	0.02	0.00	0.00	0.00	0.00	0.00	0.03
Package holidays	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Education	0.01	0.00	0.01	0.00	0.00	0.08	0.11
Catering services	0.06	0.01	0.01	0.01	0.00	0.01	0.11
Accommodation services	0.01	0.00	0.00	0.00	0.00	0.00	0.01
Personal care	0.01	0.00	0.01	0.00	0.00	0.05	0.07
Personal effects nec	0.01	0.00	0.04	0.00	0.00	0.02	0.07
Social protection	0.01	0.00	0.01	0.00	0.00	0.07	0.10
Insurance	0.01	0.00	0.00	0.00	0.00	0.04	0.05
Financial services nec	0.00	0.00	0.00	0.00	0.00	0.03	0.03
Other services nec	0.00	0.00	0.00	0.00	0.00	0.01	0.02
Total Household Consumption	0.95	0.17	0.44	0.09	0.05	2.80	4.49

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