Chapter 13
Geographical and Thematic Distribution of Publications Generated at the International Long-Term Ecological Research Network (ILTER) Sites

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Abstract The International Long-Term Ecological Research (ILTER) network is currently unmatched by other global networks in its ability to coordinate and collaborate on long-term ecological research and monitoring at a planetary scale. This offers an ideal research, information, and infrastructural platform for the Earth Stewardship initiative. However, to achieve an effective synergy between ILTER and Earth Stewardship it is critical to overcome problematic geographical and conceptual gaps in ILTER Research. To quantify these gaps we produced a new database of scholarly and grey literature generated at long-term ecological or socio-ecological research (LTER) sites worldwide. We assessed: (1) the geographical origin of LTER researchers; (2) the geographical regions where these researchers conduct their studies; (3) which thematic areas are investigated in LTER research, and to what extent do they include concepts associated with Earth Stewardship; (4) in which venues are LTER research outputs published. Regarding the production of knowledge at ILTER, we found a marked *Northern Hemispherism*: > 90 % of the ILTER publications are generated by researchers from the Northern Hemisphere. Furthermore, 89 % of ILTER publications are generated by researchers associated with LTER networks in the North Temperate region (23° N – 66° N). Regarding conceptual gaps, < 0.5 % of ILTER

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R. Rozzi et al. (eds.), *Earth Stewardship*, Ecology and Ethics 2,
DOI 10.1007/978-3-319-12133-8_13

publications are included in social sciences databases. Noticeably, however, > 99 % of all ILTER publications in the arts and the humanities are generated by researchers working in the South Temperate region (23°N – 66°N), especially Chile. Additionally, in Southern Hemisphere LTER networks research themes associated with Earth Stewardship were the most represented. Our concise analysis aims to call attention to the fact that opportunities exist for greater collaboration and complementarity in research across the ILTER Network. The southern regions can significantly add to the integration of social, ethical, and artistic dimensions to transdisciplinary socio-ecological research at ILTER, providing an intercultural and participatory foundation for Earth Stewardship.

Keywords Earth Stewardship • Ethics • Knowledge production • Long-Term Ecological Research (LTER) • Research outputs

13.1 World Distribution of ILTER Sites and Research Themes

The International Long-Term Ecological Research (ILTER) network consists of approximately 40 national-scale long-term ecological research (LTER) networks, including prospective network members. National LTER networks conduct site-based research and monitoring in a variety of ecosystems and geographies. ILTER's work addresses international ecological and socio-ecological problems through collaborative question- and problem-driven research, as well as data collection and sharing (ILTER Network n.d.). Although the formal ILTER Network was established only two decades ago in 1993, many member networks and sites have been conducting long-term monitoring and research during prior decades.

Our ability to conscientiously interact with the world is limited by our direct sources of ecological knowledge. However, a relatively small portion of the world, encompassing a limited portion of the ecological and cultural diversity of the planet is included in longer ecological studies. Distribution and availability of ecological knowledge directly affects an Earth Stewardship initiative (see Chapin et al. 2015 in this volume [Chap. 12]). Formal scientific publication or data availability is one benchmark by which knowledge is accepted into scientific (Christensen et al. 1996) and policy (Turnhout et al. 2007) communities. However, not all ecological knowledge, e.g., traditional ecological knowledge (Huntington 2000), might be suited for the predominant scientific publication forums. The thematic and geographic distribution of those forums potentially shape and reflect available ecological knowledge and interests.

In spite of its limitations, the ILTER network's ability to coordinate and collaborate on long-term ecological comprehensive research and monitoring is currently unmatched by other networks (see Maass and Equihua 2015 in this volume [Chap. 14]). Our chapter complements previous research concerning the geographic

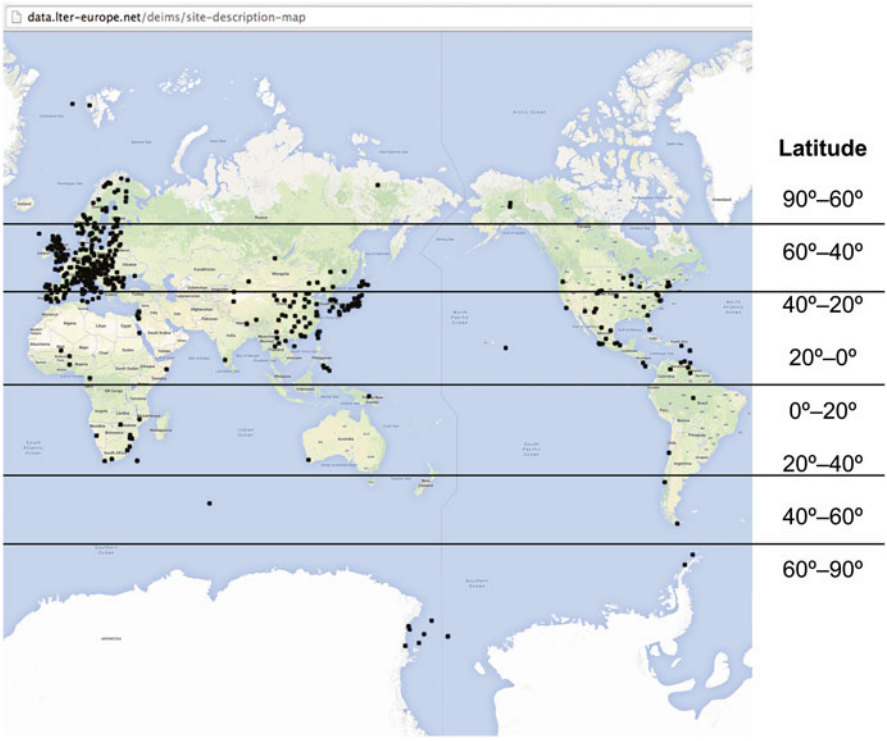

Fig. 13.1 Official map of ILTER sites as of May 2014 (Based on a screenshot from: http://data.lter-europe.net/deims/site-description-map, with latitudes overlaid from Rozzi et al. (2012))

distribution of ILTER sites. Rozzi et al. (2012) found a marked *Northern Hemispherism:* of the 543 ILTER sites distributed in 44 countries, 509 sites (93.7 %) are located in the Northern Hemisphere, while only 34 sites (6.3 %) are located in the Southern Hemisphere. Figure 13.1 shows that the majority of ILTER sites are concentrated in:

(a) the Northern Hemisphere, and
(b) within relatively small terrestrial areas of the Northern Hemisphere, mostly in Europe, and Japan.

Regarding the thematic distribution of research conducted at ILTER sites, Rozzi et al. (2012) stated that most research was purely ecological, and when it was socio-ecological it focused on socio-economic themes. They cautioned that this *economicism* was problematic because it left out aesthetic, ethical and multicultural that core attributes of socio-ecological systems.

In order to quantitatively assess thematic and geographical distributions of ILTER publications, this chapter draws on a newly compiled bibliography of research outputs from the International Long-Term Ecological Research (ILTER)

Network. Within the ILTER Network, national and supranational LTER networks and local nodes participate in various collaborations and make their research data and results available in formats for different potential re-users. In 2012, the ILTER management committee initiated a review of the network's accumulated research outputs, including publications, grey literature, data, meta-data, and other items. An initial survey of the research network's member network websites estimated the number of research output items produced by the network at 30,000–40,000, not fully counting un-collated research outputs from several major national-scale networks including Mexico, Israel, and Taiwan. For this chapter, a new analysis was conducted using titles and abstracts of approximately 30,000 research outputs in order to better understand the global distribution of research themes and locations of long-term ecological research.[1]

13.2 Data, Methods, and Results

In this section we present detailed data collection methods, results, and brief analysis of those data. The section is organized in four parts: (1) description of the data source used for this study, (2) geographic distribution of ILTER research and publications or more broadly research outputs, (3) thematic distribution of ILTER research, and (4) analysis of the venues where research outputs are published.

13.2.1 Methods and Data Source

In 2013, with the ILTER network we began to compile an accumulated bibliography of all LTER research outputs generated by its member networks. Since ILTER lacks a network-wide standard for materials eligible to be classified as research outputs, the kinds of references gathered varied among member networks and their sites. Research outputs included data and meta-data descriptions of data, patents, scholarly articles, book chapters, theses and dissertations, popular news articles, edited volumes, commissioned reports, poster and presentation abstracts, meeting and workshop proceedings, compendia, and other materials compiled by regional, national, and local LTER networks and sites.

The timespans covered by member network bibliographies also differ. For example, while the US LTER includes scholarly publications, dissertations, and theses dating from the late 1970s shortly before the US LTER Network's formal initiation, the Taiwan Forestry Research Network (TFRI, part of the national Taiwan Ecological Research Network) includes in its bibliography those kinds of items plus patents

[1] This dataset should be considered only as an initial attempt to collect a bibliography of ILTER work, and is subject to revisions and omissions as detailed later.

and commissioned industrial work dating from the 1960s, when the TFRI's annual reports first included extensive bibliographies.

In total, over 30,000 research outputs and over 30,000 meta-data[2] outputs were collected from over 30 of the approximately 40 ILTER networks, spanning approximately 40 years of research. The networks from which no bibliographic information was obtained consist of networks that are inactive (e.g., Canada and some networks in Eastern Europe and Africa) or recently established (e.g., Philippines and Malaysia). While some regional and national networks actively maintained comprehensive bibliographies of their own research outputs, others maintained bibliographies at the sub-regional or site levels.

The set of ILTER research sites is not identical to the combined sets of research sites under each of the regional or national networks. Furthermore, non-ILTER research is conducted at many ILTER research sites. Consequently, the 30,000 research outputs collected include research outputs produced at research sites and by individuals affiliated with national LTER networks, but which may not be formally part of the ILTER Network. Inclusion of such research outputs from outside the formal core of the ILTER network is consistent with the inclusion of networks that have in their bibliographies work initiated or published before the formal establishment of the ILTER network in 1994.

All available abstracts from meta-data outputs and over 5,400 abstracts from other research outputs also were collected into the same database, containing among others the following columns:

$$Author(s), Title, Year, Publication\ Name, Keywords, LTER\ Network(s), Abstract$$

In cases of multiple authorship, a single publication may appear in the bibliography of more than one LTER network. However, each publication only is counted once. Texts of the research output and meta-data titles and abstracts were automatically deconstructed into one-to-three word long alphabetized N-grams (Cavnar and Trenkle 1994) of Porter Stemmed (1980) words, excluding stop word such as "of", "is", and "the".[3] Plausible place-names were initially identified as those containing

[2] Meta-data are searchable data about data. In LTER, a meta-data record about a data set might include time and location of data collection, methods used, species and geographies involved, etc. Many LTER networks (also) publish their data and meta-data in a Global Biodiversity Information Facility repository or other repositories.

[3] For example, the title "Geographical and Thematic Analysis of Publications Generated at ILTER Sites" would be processed first into: "geograph*", "themat*", "analysi*", "public*", "gener*", "ILTER*", "site*", "geograph* themat*", "analysi* themat*", "analysi* public*", "gener*, public*", "analysi* geograph* themat*", "analysi* themat* public*", "analysi* gener* public*", "gener* ILTER* site*". Each N-gram was considered to be a plausible concept discussed in the research outputs. Other concepts included "disturb*" (capturing "disturbance", "disturbed", etc.), "chang* environment*" (capturing "changing environments", "environmental change", etc.), and "chang* impact*" (capturing "impact of change", "changes impact", etc.).

at least one capital letter in the first position of each word.[4] Three main analyses were conducted using place-name and concept N-grams as input data: place-names, research topics, and publication venues.

13.2.2 Where Are ILTER Researchers Based, Which Regions Do They Study?

Plausible place-names matched the names of a political geographic unit (including countries, autonomous regions, and major sub-national states) or a major geographical feature (such as the Andes, the Arctic, or the Pacific Ocean). The automatically coded and uncoded data were then inspected manually. Plausible place-names that appeared five[5] or more times in the data were given manual coding rules (e.g., place-names ending in "-shan" were coded as occurring in China since "-shan" is a common Romanization of the Chinese word for mountain).

A single title may include more than one place-name (such as "Kruger National Park, South Africa"). No attempts were made to identify any hierarchical or other relationships among such place-names. Errors of automatic coding were culled by adding manual coding rules (e.g., excluding matches based on the n-gram "Rio" alone, which matched many rivers in Latin and South America and parts of Europe). A small number of endemic species, such as the Adelie penguin endemic to Antarctica, were also used to geo-locate publications. From over 60,000 plausible place-names, over 11,000 place-names were coded from 10,228 publication titles. The vast majority of capitalized words in titles not accurately identifiable as place-names were excluded from the place-name analysis. Over 90 different countries and regions were identified from titles and abstracts in this way.

The geographic origin of researcher and the geographic areas that are studied by researchers were both coded into one of the following six geographic zones (A-F) (Fig. 13.2):

A = *Arctic* (> 66° N), north of the Arctic Circle;
B = *North Temperate* (66° N – 23° N), south of the Arctic Circle and north of the Tropic of Cancer;
C = *North Equator* (23 °N – 0 °), south of the Tropic of Cancer and north of the Equator;
D = *South Equator* (0 ° – 23° S), south of the Equator and north of the Tropic of Capricorn;

[4] For example, N-grams including "Antarctic", "Cascade Mountains", and "Wisconsin United States" were identified as plausible place-names. These plausible place-names are the basis of further analysis.

[5] The lower limit of five is arbitrarily chosen, but reasonable in light of other place-names and kinds of place-names that appear dozens or hundreds of times. Frequent non-place-names included any word that appeared at the beginning of the title, such as "Assessing" and "The", along with genus names.

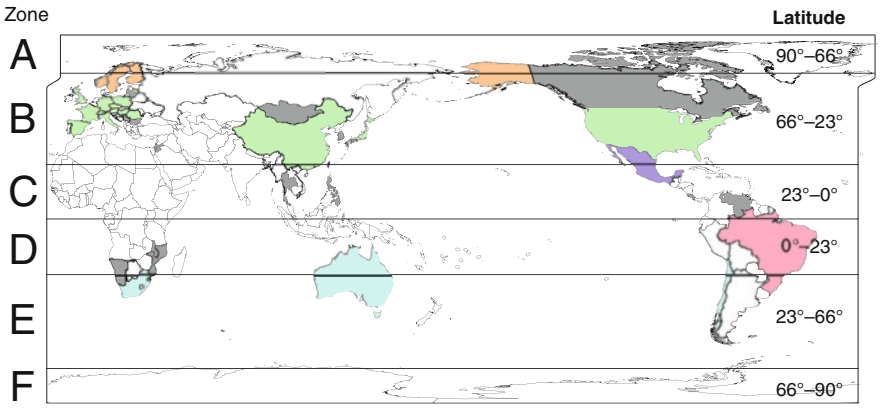

Fig. 13.2 World map representing LTER networks with research outputs and data included in this chapter (*colored areas*). The *grey* areas represent LTER networks whose research outputs and data were not accessible. The *white* areas lack national-scale LTER networks. The geographical (latitudinal) zones are the following: *A* = *Arctic* (> 66° N); *B* = *North Temperate* (66° N – 23° N); *C* = *North Equator* (23° N – 0°); *D* = *South Equator* (0° – 23° S); *E* = *South Temperate* (23°S – 66°S); *F* = *Antarctic* (> 66° S). For countries included in geographical zones A to F see Table 13.1

E = *South Temperate* (23° S – 66° S), south of the Tropic of Capricorn and north of the Antarctic Circle
F = *Antarctic* (>66°S), south of the Antarctic Circle.

For each publication or other research output, the allocation to a geographic zone was based on latitude of the place-names (when available), or based on country or biome information if no more specific place-name was identified. The list and number of LTER networks per geographic zones and countries are given in Table 13.1.[6] The origin of researchers was identified based on the location of the national LTER network from which the titles of the publications were obtained. For example, a research output listed by the US LTER concerning Antarctica would be coded as: *Researcher's Origin* = Zone B; *Research Subject* = Zone F.

Regarding which geographic zones are being studied at ILTER sites, the number of publications of articles and other research outputs excluding meta-data is similar in the Northern (56.6 %) and the Southern (43.4 %) hemispheres (Table 13.2). However, the production of meta-data is markedly concentrated in the Northern Hemisphere (95.3 %). The ratio of research outputs to meta-data (RO/M-D) is noticeably contrasting between two hemispheres: In the Northern Hemisphere the RO/M-D is 38.7 times greater than in the Southern Hemisphere. [7]

[6] There is no code for a 'global' zone, because among ILTER publications only few papers included research at a global scale.

[7] Caution should be exercised in interpreting this ratio because the generation and use of meta-data in the production of research outputs is not well characterized within LTER, and because indexed meta-data may itself refer to other sets of meta-data that have as yet uncharacterized extents.

Table 13.1 Distribution of national-scale LTER networks affiliated with ILTER

Zone	Number/+ *repeated country*	Relative percentage (%)	National LTER networks
A = *Arctic* (> 66°N)	3/+ *3*	5	Finland, Norway[a], Sweden/+ *Alaska (US), Germany-Norway Arctic Ocean*[b]
B = *Temperate North* (66°N – 23°N)	26	63	Austria, Bulgaria, Canada, Czech Republic, France, Germany, Hungary, Israel, Italy, Japan, Jordan, Latvia, Lithuania, Mongolia, People's Republic of China, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, South Korea, Spain, Switzerland, United Kingdom, United States of America
C = *North Equator* (23°N – 0°)	6	15	Costa Rica, Mexico, Philippines, Republic of China (Taiwan), Thailand, Venezuela
D = *South Equator* (0° – 23°S)	3	7	Brazil, Malawi, Mozambique
E = *Temperate South* (23°S – 66°S)	4	10	Australia, Chile, Namibia, South Africa
F = *Antarctic* (> 66°S)	0/+ *1*		*/+ Palmer Antarctica LTER (US) and McMurdo Dry Valleys LTER (US)*
Total	**42/+ *3***	**100**	

[a]Norway is a prospective ILTER member
[b]The results of this collaboration are attributed to a distinct network by LTER Europe

Table 13.2 Geographic zones studied by ILTER in terms of published articles and meta-data

Zone	Research outputs (RO)		Meta-data (M-D)		(RO/M-D) ratio
	N	Rel. (%)	N	Rel. (%)	
A (*Arctic*)	561	5.3	1,310	5.0	0.4
B (*Temperate North*)	4,615	43.7	23,263	89.6	0.2
C (*North Equator*)	801	7.6	185	0.7	4.3
Subtotal Northern Hemisphere	**5,977**	**56.6**	**24,758**	**95.3**	**0.2**
D (*South Equator*)	422	4.0	685	2.6	0.6
E (*Temperate South*)	3,510	33.2	438	1.7	8.0
F (*Antarctica*)	660	6.2	86	0.3	7.7
Subtotal Southern Hemisphere	**4,592**	**43.4**	**1,209**	**4.7**	**3.8**
Total	**10,569**	**100.0**	**25,967**	**100.0**	**0.4**

Within each hemisphere, research outputs and meta-data are concentrated in temperate zones (B and E; Table 13.2). Combined, temperate zones of the Northern and Southern hemispheres account for 76.9 % of the research outputs, and 91.3 % of the meta-data produced by ILTER sites. Equatorial regions account for only

11.6 % of the research outputs and 3.3 % of the meta-data produced by ILTER sites (C and D; Table 13.2).

Incorporating the geographical origin of ILTER researchers reveals a similar pattern: the North Temperate region (Zone B) concentrates most published outputs overall. Published outputs excluding meta-data (Fig. 13.3), and meta-data (Fig. 13.4) also show that authors of research outputs and meta-data in all regions write primarily about their own zone. Noticeably, most of the outputs concerning research on the equatorial zones are produced by researchers residing in Zones B and D (*North and South Temperate*).

No meta-data contributions came from Zone A (*Arctic*), and all meta-data concerning Zone F (*Antarctic*) were published by Zone B (*North Temperate*) (Fig. 13.4). A high number of items originating from Zones C and D were not codeable with respect to their subject zones since their titles did not clearly specify place-names (e.g., "census", "development"). Place-names that occurred a small number of times (<5) are not included.[8] These place-names can be interpreted in the LTER context to mean that there are ILTER sites about which there are not yet coherent bodies of published research.

13.2.3 Which Thematic Areas Do ILTER Researchers Study?

This section examines the geographic distribution in terms of LTER research topics: What are the thematic contrasts among regions? To answer this question, the data source is the same as in Sect. 13.2.2, and the thematic concepts were classified into eight categories (Table 13.3). The classifications reflect major themes of the ILTER Strategic Plan (ILTER Network 2006) and stewardship themes.

For each of the categories of research concept, researchers from LTER networks in the North Temperate region (Zone B) generated more than 75 % of the total publications (Fig. 13.5). For all categories, researchers from LTER networks in the Southern Hemisphere have generated approximately 10 % of the publications,

[8] Regarding our methodology it is important to note that the lack of detailed coding of infrequent place-names is not detrimental to the scale of analysis conducted with this method because of its low numbers. In Figs. 13.3 and 13.4, and Table 13.2 each article title may contain more than one place-name, and some place-names may represent more than one geographical location (e.g., the municipality of China in the Mexican state of Nuevo León, the People's Republic of China, and the Republic of China, etc.). Figure 13.3 counts the number of relationships between research networks (known from their network homes) and the geographic zone investigated (inferred from place-names in article/data titles). Table 13.2 counts the number of times an identifying place-name occurs in each of the zones in articles and data. The number of research outputs/meta-data reported for a zone in Table 13.3 is equal to or lower than the sum of the number of articles/meta-data where that zone is the right side of Fig. 13.3. Table 13.2 counts a small number of research outputs/meta-data not counted in Fig. 13.3, namely those having an uncoded researcher origin Zone due to inadequate meta-data. Finally, it is also important to note that titles of meta-data contained more N-grams about methods and theoretical approaches than did titles of publications.

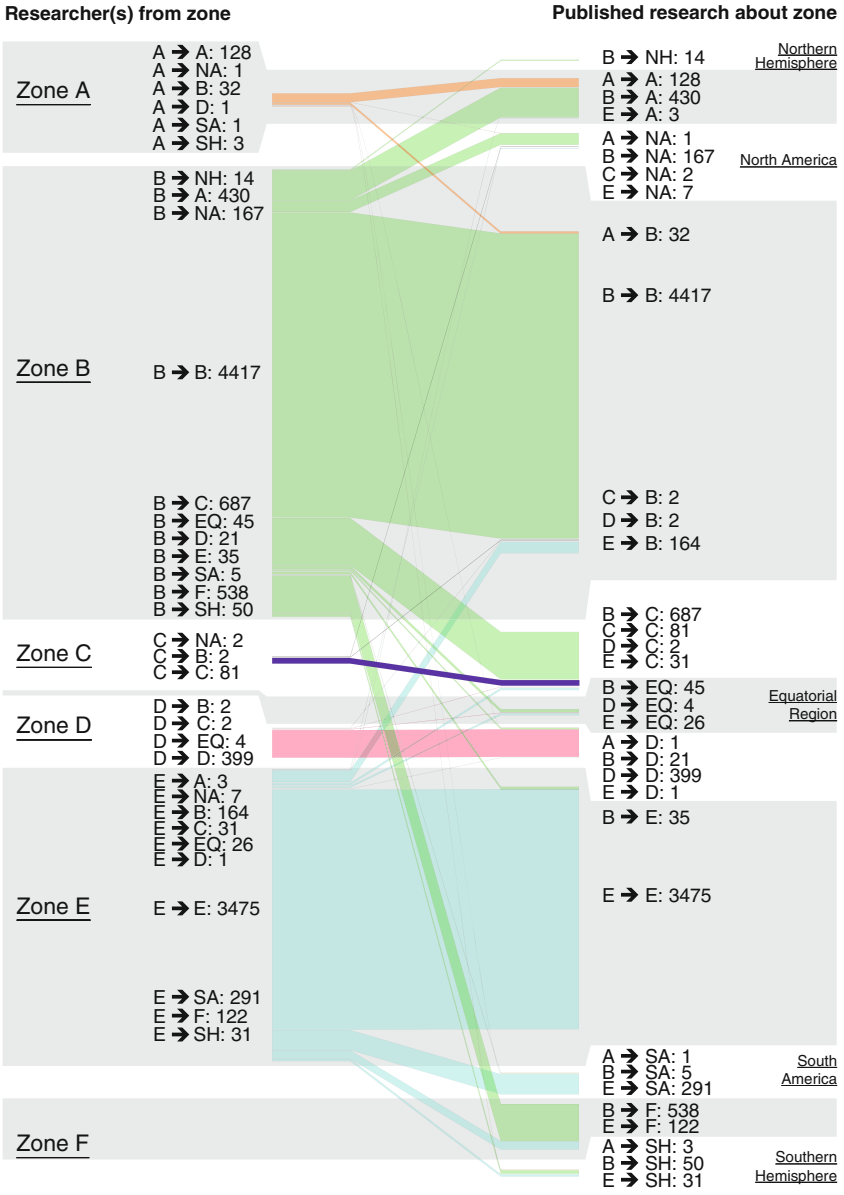

Fig. 13.3 Directions of LTER research considering the geographical origin of LTER researchers (*left column*) and the geographical region covered in the research outputs (*right column*) in terms publications, excluding meta-data. Vertical heights are proportional to the number of research originating from, or about, a Zone. For latitudinal ranges and countries included in zones A to F see Table 13.1. The following zones are given where a research output provides no more detailed geographic information: *NH* Northern Hemisphere, *EQ* Equatorial, Includes Africa, Tropics; *SH* Southern Hemisphere, *NA* North America, *SA* South America, *AF* Africa. Colors of the Zones match those given in Fig. 13.2

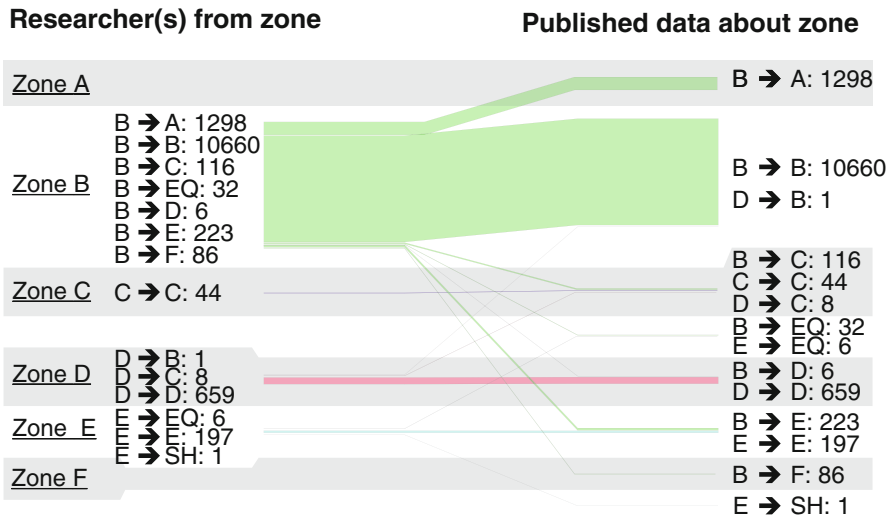

Fig. 13.4 Directions of LTER research considering the geographical origin of LTER researchers (*left column*) and the geographical region covered in the research outputs (*right column*) in terms publications, considering meta-data only. For latitudinal ranges and countries included in Zones A to F see Table 13.1; for color matches of the Zones see Fig. 13.2

mostly in the South Temperate region (Zone E). Therefore, in most categories the proportion of Northern/Southern Hemisphere ILTER publications is 9:1. In addition, the equatorial zones C and D are the least represented, accounting for less than 5 % of the publications in all categories.[9]

Regarding the thematic areas, *management* and *stewardship* are the categories that include higher numbers of ILTER publications; both have more than 5,000 research outputs (Fig. 13.5). *Location*, *methods*, and *monitoring* include more than 3,000 research outputs, and *scale* more than 2,000. *Event* and *LTER* are the least represented research themes, each including a total of less than 2,000 research outputs.

[9] It is important to note that Zone C is not fully represented in the data included in Figs. 13.5 and 13.6 because the data for Mexico LTER are incomplete, and several Asian LTER networks' databases are still in the early stages of work. Also, not all zones had a network with publications about concepts that were shared by more than seven other networks. (Seven networks as a cutoff is based on the proposition that ILTER Network-wide research should be defined as that which could draw on work from each of the continents. It is also based on the practical consideration that the other 99% of the approximately 10,000 possible concepts not represented here is too vast to code reliably into relevant categories.)

Table 13.3 Concepts included in each research thematic category

Event = Things that happen to the biophysical world (event*, disturb*, storm*, damag*, acidifi*, extrem*)
Location = Spatial (kinds of) location and processes {local*, catchment*, air*, hydrolog*, sediment*, stream*, fauna*, wetland*, aquat*, adapt*, state*, ground*, stress*, arctic*, alien*}
LTER = Network research, synthesis {network*, shortterm*, workshop*, longterm* studi*, lter*, ilter*, integr*, review*}
Methods = Theories about and measures of socioecological systems {case* studi*, evid*, flow*, precipit*, map*, regim*, concept*, methodolog*, techniqu*, commun* composit*, detect*, chang* climat*}
Management = Concepts and policies concerning human actions on the world {theori*, implic*, project*, establish*, budget*, load*, perspect*, remov*, reduct*, problem*, health*, histor*, vulner*, pressur*, uncertainti*, reconstruct*, chang* environment*, challeng*, promot*}
Monitoring = Using measures of the world over time to understand change {natur* regener*, stabl*, shift*, learn*, sens*, remot* sens*, satellit*, forest* monitor*, recoveri*, paramet*, regener*, consequ*, eutroph*, assess*, monitor*, carbon* flux*}
Scale = Understanding the world across locations {biodivers*, biospher*, food* web*, gradient*, complex*, global*, transfer*, fluctuat*}
Stewardship = Human interventions on the world {predict*, strategi*, risk*, futur*, biospher* reserv*, human*, emiss*, appli*, air* pollut*, crop*, artifici*, rural*, plan*, design*, polici*, district*, framework*, farm*, area* protect*, forestri*, programm*, implement*, social*, govern*, scheme*, optim*, agricultur* landscap*, econom*, activ* human*, dam*, ecolog* impact*, chang* impact*, conserv* natur*}

Categories are based on root words common to publication titles and abstracts published by at least eight national LTER networks (=20 % of all ILTER member networks), with the exception of the *LTER* category which includes the concept *LTER* appearing in only publications of seven national LTER networks. This table lists the concepts in each category. The categories as constructed here as mutually exclusive, and for convenience of analysis. Doubtless, there are many other useful ways to categorize and interpret this data

Regarding the distribution of research themes within each of the LTER networks, it is salient that *stewardship* is the most represented research area in the Southern Hemisphere. It includes more than 40 % and 20 % of the publications generated by South Equator (Zone D) and Temperate (Zone E) zones, respectively (Fig. 13.6). In the Northern Hemisphere, stewardship is also well represented in North Temperate (Zone B). In this zone, management and stewardship combined account for 40 % of the publications. At ILTER sites in the North Temperate Zone, broad scale research represents less than 10 % of the research outputs. In addition, the Arctic (Zone A) is the geographical region that is most concentrated on local topics, having more than 35 % of its research outputs focused on location. Hence, broad scale research is better resented in the Southern Hemisphere LTER networks where it accounts for more than 10 % of the research outputs in zones D and E (Fig. 13.6).

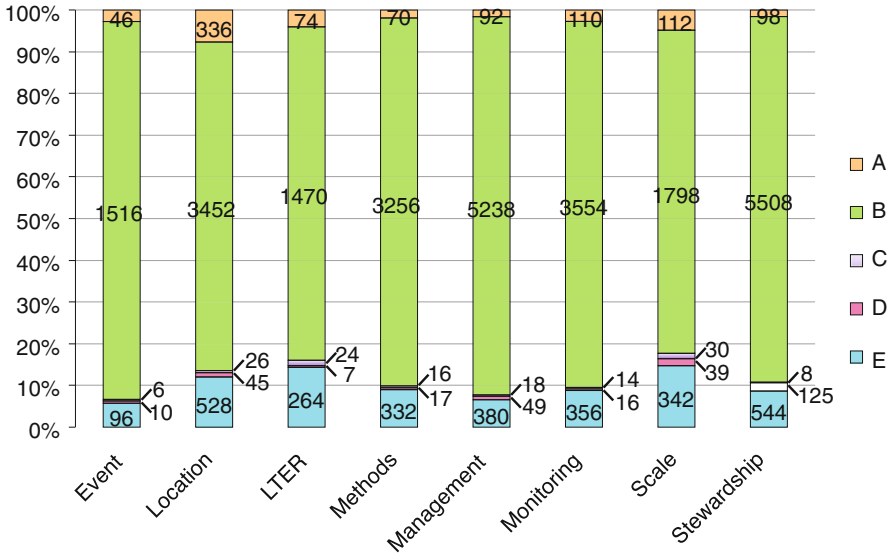

Fig. 13.5 Absolute numbers (in the bars) and relative percentage (indicated by Y axis) of ILTER publications for each of the defined research concepts contributed by contributed by ILTER researchers from each of the geographical zones (A to E). Geographical Zone F is not included because all researchers in Antarctica are from other parts of the world. For latitudinal ranges and countries included in geographical zones A to E see Table 13.1; for color matches of the Zones see Fig. 13.2

13.2.4 From Which Geographical Region and in Which Venues Are LTER Researchers Publishing?

A first of level of analysis was conducted based on the ISI's Web of Knowledge database service. Publication venues were identified by automatically matching ISI's Master Journal List (http://ip-science.thomsonreuters.com/mjl/) with publication names from the collected ILTER bibliographies.[10] The majority (89 %) of publication venues is generated by researchers based in the North Temperate region (in Zone B) (Table 13.4). Zone B together with zone A (Arctic) account for 90 % of the ISI-ILTER publications. Adding Zone C (North Equator), the proportion of

[10] It is important to note data quality issues. They included: typos and inconsistent spelling and use of publication names in national- and regional-scale bibliographies, lack of DOIs, and lack of public availability of some documents listed in bibliographies. These issues existed in bibliographies from both small and large networks regardless of geographic location. Furthermore, Asian and non-Latin journal names presented an additional challenge since they are not well represented in the ISI Master Journal List. The impact is clear from the ISI/non-ISI ratios for CERN and Brazil national-scale networks, which both listed many publications in Chinese and Portuguese publication venues, respectively (see Fig. 13.7).

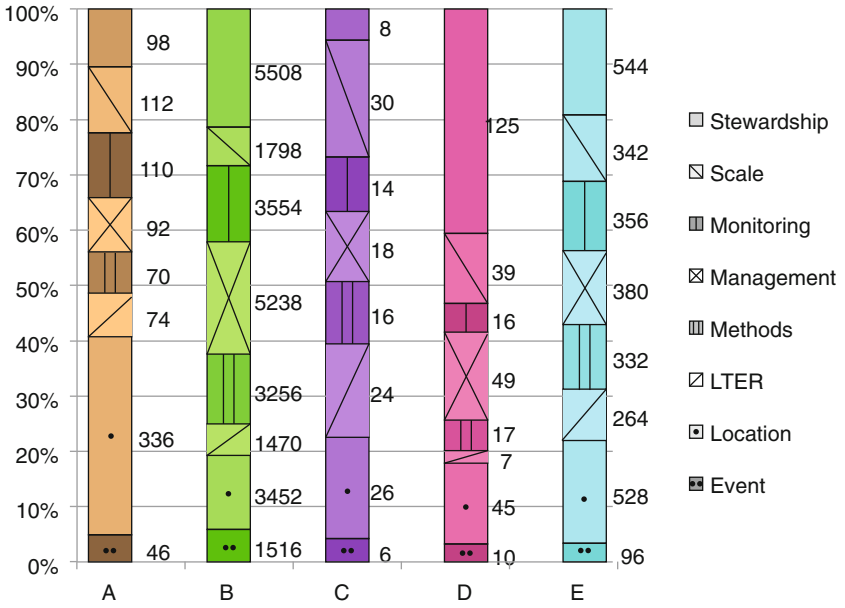

Fig. 13.6 Number and relative percentage each of the defined research concepts within the accumulated number of LTER publications produced by researchers based at each of the geographical zones, A to E. Geographical Zone F is not included because all researchers in Antarctica are from other parts of the world. For latitudinal ranges and countries included in geographical Zones A to E see Table 13.1

Table 13.4 ISI titles published from each Zone. For latitudinal ranges and countries included in Zones A to E see Table 13.1

Zone	Number of ISI titles	Fraction of ISI titles (%)
A	112	0.64
B	15,734	89.33
C	706	4.01
D	500	2.84
E	561	3.19
TOTAL	17,613	100.00

ILTER publications generated in the Northern Hemisphere accounts for 94 % of the world's total. Therefore, for ILTER ISI publications the Northern/Southern Hemispheres ratio is even greater than 9:1.

Most LTER research outputs listed on LTER bibliographies are not published in ISI journals (Fig. 13.7).[11] Notably, networks in regions with numerous local

[11] It is important to note that there are an unknown number of LTER research outputs that are not listed in bibliographies, and the national and site-level bibliographies themselves are often inconsistent in what they report as publications.

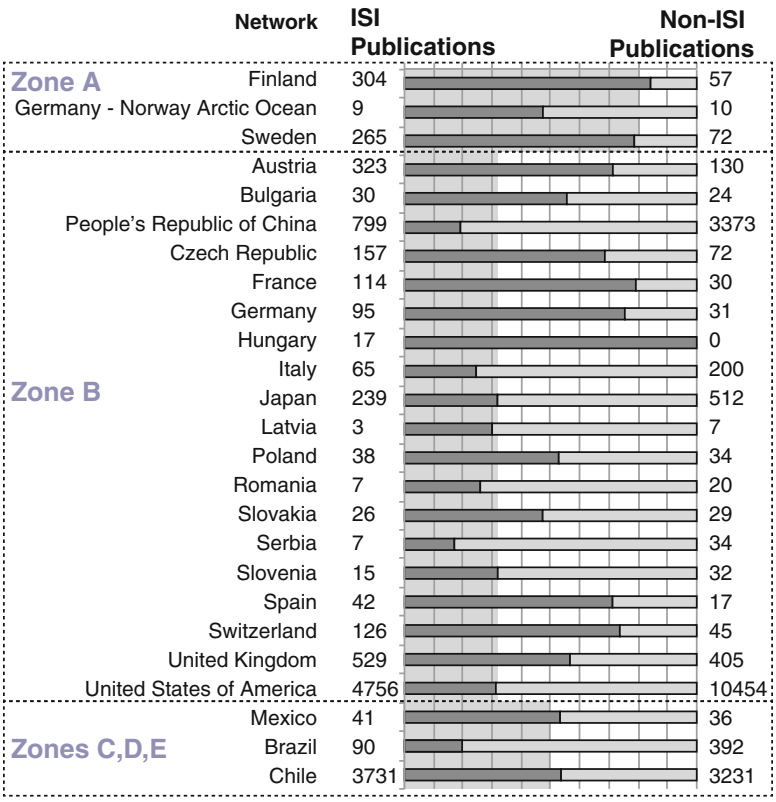

Fig. 13.7 Number and relative percentage of ISI and Non-ISI publications produced by researchers of each of the LTER networks associated with ILTER. For latitudinal ranges and countries included in zones A to E see Table 13.1

language publication venues such as Japan, China, and those in Eastern Europe appear to publish relatively less in ISI journals. Networks in Zone A (*Arctic*) have the highest proportion of their publications in ISI journals. This may indicate careful targeting of publication, and/or success in getting local publication titles listed in ISI. In Zone B (*North Temperate*), European countries tend to have more ISI than non-ISI publications. In contrast the US, Japan, and specially China have larger numbers of non-ISI than ISI publications. In the US many of the non-ISI publications include theses and dissertations. China, in turn, includes many publications in national non-ISI venues.

Regarding Zones B, C, and D, it is noticeable that Mexico and Chile produce more ISI than non-ISI publications. The opposite is true for Brazil. In the analyses summarized by Fig. 13.7 it is important to note that there probably significant data missing due to incomplete bibliographies available in national-scale networks in Zones C, D, and E. Networks included in these zones have not made network-wide bibliographies readily available. For example, Red Mex-LTER in Mexico includes

11 research sites and approximately 200 active and interested researcher members, yet had only compiled an internal list of fewer than 100 ILTER research outputs as of early 2014. TFRI in Taiwan has a history of over 50 years of intensive production of numerous scholarly and other publications, each compiled in annual reports, which has accumulated a vast bibliography that is incompletely digitized. Collectively, these gaps highlight broader problems recognizing and sharing these networks' outputs as bodies of ecological knowledge within the formal scientific publication model. These gaps also highlight different priorities among national-scale LTER networks with respect to how ecological knowledge is to be accessed. For example, TFRI also maintains an extensive physical library of pre-war long-term Japanese ecological research that is currently only accessible and searchable in person.

Core databases for ecological and socio-ecological sciences were used to analyze the distribution of publication interests for each geographical zone.[12] In 11 of the 14 bibliographic databases, the North Temperate region (Zone B) accounts for over 50 % of all ILTER publications (Table 13.5). The only three databases that have more publications generated in other ILTER geographic regions are: BIOSIS Reviews Reports and Meetings with over 50 % of the publications generated in North Equator (Zone C); Arts & Humanities Citation Index and Current Contents Arts & Humanities with over 99 % of the publications generated in South Temperate (Zone E). Therefore, in the fields of the arts and humanities the Northern/Southern Hemisphere ratio is 0.1/9.9.

The scarcity of publications in social sciences, engineering, and medicine databases is noteworthy. Only 63 ILTER publications were found in the Social Sciences Citation Index, and 60 in the Current Contents – Social Sciences & Behavioral Sciences. Combined, these two databases account for less than 0.2 % of all ILTER publications. Five large databases of natural sciences (*Science Citation Index*, *Social Sciences Citation Index*, *BIOSIS Previews*, *Current Contents – Agriculture*, *Biology & Environmental Sciences*, and *Zoological Record*) concentrate 90 % of all ILTER publications.

13.3 Discussion and Implications for Earth Stewardship

The data presented here confirm both the geographic and the conceptual biases in ILTER research. A *Northern Hemispherism* is quantitatively demonstrated by a Northern/Southern Hemispheres ratio greater than 9:1 in ILTER ISI publications, and an even higher ratio for meta-data. Furthermore, within the Northern Hemisphere, the production of knowledge is concentrated in the Temperate region (Zone B), which includes the US, Western Europe, and North-East Asia.

[12] For each ISI publication attributed to a zone, the ISI index in which that publication appears is counted. Note that some publications appear in more than one ISI index.

Table 13.5 Number and relative percentage of articles published in core databases for ecological and socio-ecological sciences generated by ILTER researchers from each geographical zone. For latitudinal ranges and countries included in geographical Zones A to E see Table 13.1. Geographical Zone F (Antarctica) is excluded because no research is a resident of the Antarctic region

	Zone A		Zone B		Zone C		Zone D		Zone E		Total	
Index	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Arts & Humanities Citation Index	0	*0.0*	6	0.6	0	0.0	0	0.0	1,059	99.4	**1,065**	100
BIOSIS Previews	482	*5.1*	6,397	67.8	32	0.3	87	0.9	2,435	25.8	**9,433**	100
BIOSIS Reviews Reports and Meetings	0	*0.0*	30	47.6	32	50.8	0	0.0	1	1.6	**63**	100
Current Contents - Agriculture, Biology & Environmental Sciences	469	*5.3*	6,338	71.4	29	0.3	81	0.9	1,955	22.0	**8,872**	100
Current Contents - Arts & Humanities	0	*0.0*	6	0.6	0	0.0	0	0.0	1,059	99.4	**1,065**	100
Current Contents - Clinical Medicine	0	*0.0*	5	71.4	0	0.0	0	0.0	2	28.6	**7**	100
Current Contents - Engineering, Computing & Technology	6	*2.3*	254	96.9	0	0.0	0	0.0	2	0.8	**262**	100
Current Contents - Life Sciences	61	*4.8*	807	64.0	1	0.1	6	0.5	385	30.6	**1,260**	100
Current Contents - Physical, Chemical & Earth Sciences	118	*7.9*	1,262	84.9	2	0.1	8	0.5	96	6.5	**1,486**	100

(continued)

Table 13.5 (continued)

Index	Zone A		Zone B		Zone C		Zone D		Zone E		Total	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
Current Contents - Social & Behavioral Sciences	4	*6.7*	48	80.0	1	1.7	0	0.0	7	11.7	**60**	100
Science Citation Index	569	*5.6*	7228	71.3	24	0.2	71	0.7	2248	22.2	**10,140**	100
Science Citation Index Expanded	569	*5.6*	7,228	71.1	35	0.3	87	0.9	2,248	22.1	**10,167**	100
Social Sciences Citation Index	4	*6.3*	50	79.4	1	1.6	0	0.0	8	12.7	**63**	100
Zoological Record	431	*5.2*	5,272	63.2	33	0.4	79	0.9	2,526	30.3	**8,341**	100
Total	**2,713**	***5.2***	**34,931**	**66.8**	**190**	**0.4**	**419**	**0.8**	**14,031**	**26.8**	**52,284**	**100**

Consequently, information and perspectives expressed in the published literature may be less sensitive to socio-ecological phenomena and concepts grounded in other regions.

The geographic bias is also grounded in the uneven distribution of ILTER sites around the globe. As illustrated in Fig. 13.2, currently vast zones in the African, Asian and Latin American continents lack LTER networks. Consequently, current long-term ecological and socio-ecological research programs are missing some of the world's most diverse countries and regions in terms of both biological and cultural diversity.

Regarding cultural diversity, it is critical to note that standards and embedded concepts employed by LTER networks to obtain and share data, and to collaborate, do not facilitate sharing or reuse of data and underlying theories that lack a tabular or matrix representation of discreet values (Li 2014). This is clearly seen in discussions about "long-term" data sets and observations valued for their large quantitative size in time or geography, and in the information infrastructures that make such data desirable, describable, achievable, and sharable. Difficult to fit into that model are interview transcripts, images of interactions among human and natural communities, or models of such interactions. In particular, LTER's EML standard to describe ecological data encodes a bureaucratic hierarchical understanding of ecological knowledge production and prioritizes attribution rather than stewardship of data (Li 2013). Nature is thereby framed in service of largely individual knowledge discovery, rather than in terms of stewardship, advocacy, or responsibility for the underlying life processes and relationships.

The conceptual bias is expressed in the scarcity of publications in the social sciences. The recent call to implement long-term socio-ecological research in the ILTER network (Maass and Equihua 2015 in this volume [Chap. 14]) will have to address the fact that less than 0.5 % of ILTER publications are indexed in social sciences bibliographic databases. However, it is promising that the South Temperate region (Zone E), especially Chile, is leading the publications in the humanities and arts, accounting for over 99 % of ILTER publications in these thematic areas. Additionally, the Chilean LTSER network is generating methodologies to integrate ecological sciences and environmental ethics that can be adapted by LTER programs in other regions (Rozzi et al. 2008; Aguirre Sala 2015 in this volume [Chap. 15]).

During the last decade Northern Hemisphere LTSER networks in the US (Redman and Miller 2015 in this volume [Chap. 17]), Europe (Singh et al. 2013), and Japan (Shibata 2015 in this volume [Chap. 3]) have called attention to the need to incorporate social dimensions of ecological research into ILTER. To achieve this goal, we need to consider how research infrastructures might emerge and be adapted to suit those needs. Presently, LTER networks across the world have largely adopted and adapted the US LTER's infrastructure for meta-data, and with it notions of what is or is not to be considered valid forms of research. For example, the Kepler workflow engine is becoming increasingly optimized to handle large anonymous sensor networks, and offers little value to handling interview transcripts. The GBIF data

and meta-data repository and data standard, used by LTER networks worldwide, was passed over for official adoption by the ILTER in favor of the infrastructure developed by the US LTER.

For an Earth Stewardship initiative, it is relevant to consider the extent to which ethnographic methods that focus on individuals, sites, or individual networks research can be incorporated. This type of research has been underrepresented in Northern Hemisphere long-term socio-ecological (LTSER) networks, which have focused on socio-economic variables (Rozzi et al. 2012, p. 303). South American and Asian socio-ecological research initiatives highlight the relevance of traditional ecological knowledge, as well as ethical, aesthetic, and spiritual values (see chapters by Shibata, Gao, Sarmiento, Mamani-Bernabé, Rozzi, Aguirre Sala, May Jr, in this volume [Chaps. 3, 4, 5, 6, 8, 9, 15, 27]). Overall, the language and practice of long-term ecological data favors quantitative measures of single parameters. Interestingly, today local forms of ecological knowledge are beginning to appear on the conceptual radar of ILTER.

Technological advances in the LTER networks, such as automated sensor networks, present a bias toward the Northern Hemisphere. In the Southern Hemisphere, LTER networks face unique and great challenges in terms of costs to build and maintain capital-intensive infrastructures. Additionally, novel technological infrastructure, which monitors nature in more automated ways, increases the distance between humans and nature. However, an Earth Stewardship initiative requires a social engagement and the participation of researchers from diverse regions and cultures. Therefore, it is necessary to also develop novel participatory models to promote an inclusive intercultural approach to LTER research.

As demonstrated by our analyses, currently it is not possible to interrogate directly the knowledge superstructure that the various LTER infrastructures have built collectively. As we advance toward that goal, the role played by ILTER infrastructure, the geographical and conceptual constraints in the production of knowledge at ILTER cannot remain invisible. The marked geopolitical biases in the knowledge production at ILTER suggests that it is urgent to better balance the inclusion of quantitative and qualitative forms of knowledge from different regions and cultural traditions. Epistemologically, the inclusion of broader geographical areas and qualitative research will broaden the spectrum of ecological forms of knowledge. Ethically, it will broaden the spectrum of values and the participation of local and regional communities. Our concise analysis aims to call attention to the fact that ILTER research outputs could better represent the multiplicity of existing ecological worldviews in order to avoid excluding diverse stakeholder communities to Earth Stewardship, and enhance intercultural and interregional dialogues and collaborations in this planetary initiative.

Acknowledgements This chapter was made possible by a project of the International Long-Term Ecological Research (ILTER) Network, in conjunction with FinLTSER, the THULE Institute, and the Academy of Finland, SYKE – the Finnish Environment Institute, the Centre for Ecology and Hydrology (UK), and the support of the Institute of Ecology and Biodiversity (IEB-Chile).

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