A central theme of this book is that there is a strong mutual dependence between explanatory theory, available data and analytical method in determining the lurching progress of ecological knowledge (Fig. 1.1). The two central arguments are first that limits in each of theory, data and method have continuously constrained advances in understanding ecological systems and second that recent revolutionary advances in data and method are enabling unprecedented expansion of ecological investigation into areas of inquiry previously unapproachable due to lack of fine-detail, broad scale data on environmental conditions, the distribution and performance of organisms, the lack of sufficient computational power to process and analyze such voluminous data sets, and inadequate analytical tools to investigate pattern–process relationships among many interacting entities over large, spatially complex landscapes.

1.1 Mutual Dependence of Theory, Method, Data

There is a strict interdependence in science between theory, method and data. It is not possible to decouple these in the practice of science. In some sense it would be desirable if one could. When each corner of this triangle (Fig. 1.1) is dependent and limited by the others there is a feedback where the limitations of each further limit progress in the others. If these could be decoupled conceptually it would perhaps improve the rate of scientific advance. Classic conceptions of the scientific method...
typically assume one of two decouplings. First, the “Baconian” inductive approach proposes a decoupling in which observations (data) are a reflection of reality uncontaminated by implicit theories and unaffected by methods of data collection, such as sampling and measuring (Fig. 1.2). In this conception, the mind, its preconceptions and biases is seen as an obstacle to true understanding and instead the scientist collects data dispassionately and then theory regarding causation emerges inductively from the observations (Bacon 1620). In contrast, the “Cartesian” approach proposes a converse decoupling in which a sentient observer imagines processes governing ideal systems (Descartes 1637). In this conception, it is observation that is unreliable and ideal and eternal conceptions of theory are truly reliable (Fig. 1.3).

Each of these decouplings between theory, method and data are easily refuted. Despite the fact that they are over 400 years old, neither is a realistic view of any actual process used by a practicing scientist to link method, data and theory to build understanding. In the former case, it is easily argued that observations are always “infected” by implicit theory and affected by methods of sampling and measuring. Therefore, it is virtually impossible to obtain purely objective data from which to induce generalizable theory. In addition, due to the logical fallacy of affirming the consequent, patterns observed through induction do not provide proof for a theory with which they may be consistent (Fig. 1.4). The latter case assumes theories are created by the mind, independently from the historical context of current and past explanation. They would be unaffected by the scope and limits of available empirical observations related to the entities and processes related to the theory or by the methods of measurement and analysis that these data are customarily subjected to. These seem severe and unjustifiable assumptions. In addition, strict Cartesian distrust for observation makes empirical evaluation of theory difficult.

Fig. 1.1  There is a mutual interdependence between methods of observation and analysis, kind and character of data collected, and theories used to explain phenomena. Importantly, there is no possible decoupling by which they will be independent, lending a kind of circularity to the logic of scientific justification. Sometimes, this promotes a self-confirmatory process, with a theory proposing a method designed to produce data that will confirm the theory.

Fig. 1.2  Baconian process of induction by which data are collected “objectively”, which then suggest appropriate methods for analysis and interpretation, which then suggest the correct theory for explanation.