Network (BN) framework. Different degrees of belief associated with perceptions of risk, ranging from subjective expert opinion (for example, from park managers and traditional Aboriginal owners) to objective quantitative estimates derived from frequentist statistics (for example, the probability density functions reported here), can be integrated and the results communicated using simple influence diagrams and decision trees.

# 3.11 Tropical Rivers Inventory and Assessment Project (TRIAP)

## 3.11.1 Background

During 2005–06, the Department of the Environment and Heritage invested $0.3 million from the Natural Heritage Trust to fund the Tropical Rivers Inventory and Assessment Project (TRIAP), administered by Land and Water Australia's Tropical Rivers Programme, and managed by ***eriss***. The TRIAP commenced in late 2004, with the objective of establishing an information base for assessing change, undertaking ecological risk assessments of major pressures, supporting local and indigenous management, and strengthening holistic approaches for managing tropical rivers and their associated wetlands.

The project examines 51 catchments across northern Australia (from Broome in the west to the western tip of Cape York), covering some 1 192 000 km$^2$ (Figure 3.20). There are three focus catchments, representing each State or Territory within the study region, that are being assessed in more detail. These are the Fitzroy River in Western Australia, the Daly River in the Northern Territory, and the Flinders River in Queensland.

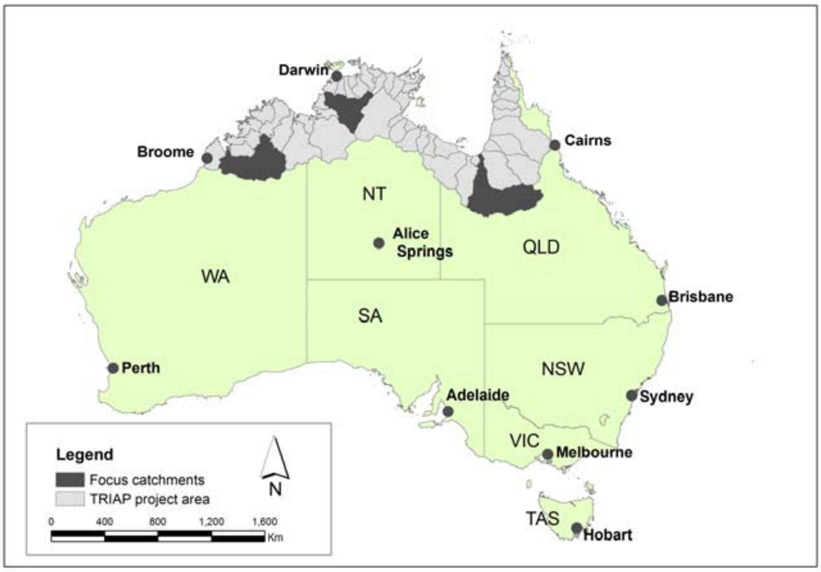


**Figure 3.20** Location of Tropical Rivers Inventory and Assessment Project

The outcomes of this project, due for completion in 2006–07, will inform and support holistic approaches for management of tropical rivers and wetlands by the various stakeholder groups in the region. Summaries of progress on two of the TRIAP's three sub-projects (Sub-project 1 – Inventory and mapping, and Sub-project 2 – Risk assessments) are provided below. The third Sub-project (Development of a framework for the analysis of ecosystem services provided by aquatic ecosystems) was completed in November 2005, and a final report is currently in preparation.

### 3.11.2 Sub-project 1: Inventory of the biological, chemical and physical features of aquatic ecosystems

The main objective of Sub-project 1 is to develop a multiple-scale inventory of the habitats and biota of the rivers and floodplains within LWA's programme area for the Tropical Rivers funding programme. The datasets collated for the project have been created using a consistent and recognised datum and projection, and the metadata records are created and compiled to national and international standards. In many cases this has required a substantial amount of work to bring the originally supplied data set up to the required common standard required for the final project database.

Major activities undertaken through 2005–06 are listed in Table 3.4. These include (i) the ongoing collation of biophysical datasets; (ii) analysis, interpretation and classification of the collated datasets; and (iii) compilation of a Geographic Information System (GIS) and associated standardisation of the datasets and metadata records.

**TABLE 3.4 MAJOR ACTIVITIES OF SUB-PROJECT 1**

| | |
|---|---|
| *Data and metadata standards* | A hierarchical directory structure has been applied for the storage and management of spatial datasets. All spatial datasets are maintained in a geographic projection, using the Geocentric Datum of Australia 1994.<br><br>Following a review of procedures for the creation and management of metadata within the Department of the Environment and Heritage, metadata for databases/datasets has been progressively created/updated to the ISO19115 standard. Significantly, all datasets now have a metadata record attached to them. |
| *Compile existing GIS datasets at 2.5M, 250K and other scales* | Collation and compilation of data for the inventory component of the project has been completed, with data compiled at two broad scales (continental – 1:2 500 000; and catchment scale – 1:250 000). Data for the 'focus' catchments has been collated at the catchment scale, or better. |

| | |
|---|---|
| | Data collation is continuing at a reduced level to support risk assessment activities within the three focus catchment, focussing on the collation of datasets representing the distribution of feral animals, weeds, rare and threatened species, and temporal variations in land useand landcover.<br><br>During the year, existing collated datasets have been reviewed and updated to ensure that the latest versions of key datasets (geology, topography, hydrology) are held by the project database. |
| *Identify, collate and analyse additional for reach attributes* | Additional national (eg AUSRIVAS, OZCAM, BirdsAtlas) and State/Territory faunal and floral databases were accessed and data extracted to identify the distribution of specific species at catchment and focus catchment scale.<br><br>Additionally, new spatial datasets were created for hydrological, geomorphological and water quality attributes.<br><br>Analyses have been undertaken to look for patterns/relationships of biophysical attributes across the tropical rivers |
| *Develop geomorphic classification / typology* | Continental scale and focus catchment scale geomorphic classifications were completed. |
| *Estuary classification review* | Data collected has included information on tidal character and non-tidal processes, cyclone tracks and locations of land crossing, climate change and variability projections and estuarine classification systems. Classification systems have been reviewed. This component is approaching completion. |

During the year classification of the geomorphic typology of the river systems was completed at both continental and catchment scales. At the continental scale, seven different classes were used for classification. The total lengths across all 51 river catchments of the different continental geomorphic classes are shown in Table 3.5.

Up to twelve different geomorphic categories were used for the Focus catchment level classification. This more detailed system of classification recognises both the greater amount of information available for the focus catchments as well as the more intensive use that will be made of the classification system to support the risk assessment process. The length of the different classes in each focus catchment is shown in Table 3.6. The Fitzroy River showed the greatest diversity in terms of geomorphic classes identified at the catchment level.

**TABLE 3.5 CONTINENTAL GEOMORPHIC CLASSES**

| Continental geomorphic class | Length of river class (km) |
|---|---|
| Bedrock channel | 10 857 |
| Bedrock confined | 13 489 |
| Estuarine | 4 400 |
| Lake/swamp | 3 373 |
| Level alluvial plain | 11 058 |
| Rolling alluvial plain | 4 063 |
| Undulating alluvial plain | 14 114 |

**TABLE 3.6 FOCUS CATCHMENT GEOMORPHIC CLASSES**

| Reach Classification | Flinders River (km) | Fitzroy River (km) | Daly River (km) |
|---|---|---|---|
| Bedrock channel | 580 | 609 | 372 |
| Bedrock confined | 3957 | 3138 | 2355 |
| Estuary | 274 | 111 | 80 |
| Billabong / lake / swamp | Not present | 5.6 | 46 |
| Anabranching | 23274 | 3639 | 847 |
| Non-channelised | 238 | 62 | 73 |
| Chain of ponds | 97 | 40 | 454 |
| Meandering | 786 | 302 | 431 |
| Low sinuousity | 450 | 175 | 203 |
| Floodout | Not present | 40 | Not present |
| Gully | Not present | 21 | Not present |
| Wandering | 271 | Not present | Not present |

A preliminary vegetation classification system for each focus catchment has been produced by integrating slope and vegetation datasets. Figure 3.21 illustrates the distribution of the vegetation classes identified within the Fitzroy catchment.

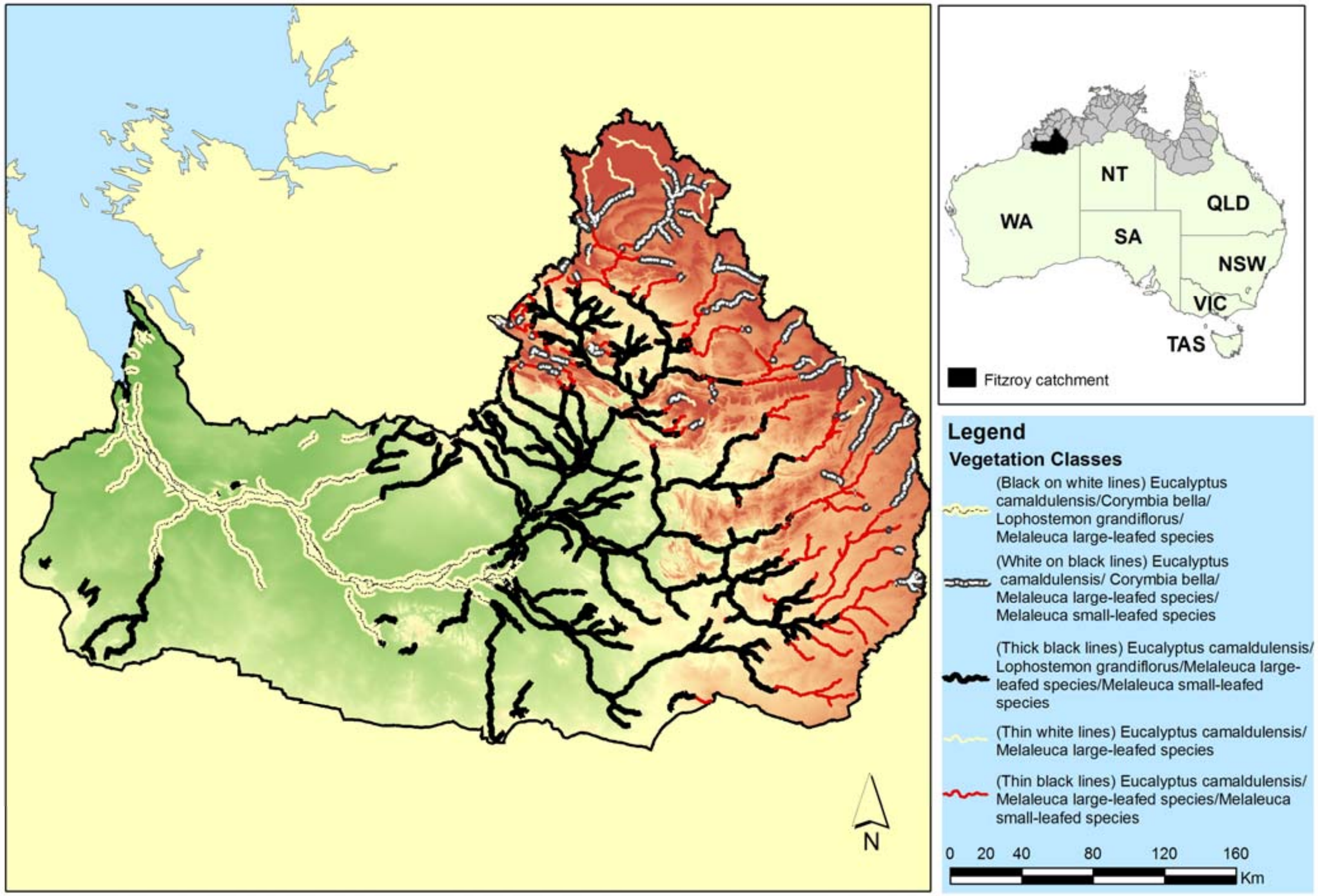


**Figure 3.21** Distribution of the vegetation classes within the Fitzroy catchment

A classification system has been developed to describe the hydrological (flow regime) characteristics of each focus catchment. Flow regime is a fundamental characteristic that defines the biological diversity of river systems in the northern wet-dry tropics.

The hydrological variables that can be used to classify flow regime are generally related to overall flow variability, flood patterns and extent of intermittency and can be derived from long-term streamflow data from a gauging station. Long-term flow data for the three focus catchments – Daly River (Northern Territory), Fitzroy River (Western Australia) and Flinders River (Queensland) (Figure 3.22) – were used to derive hydrology variables to classify rivers into flow regime types.

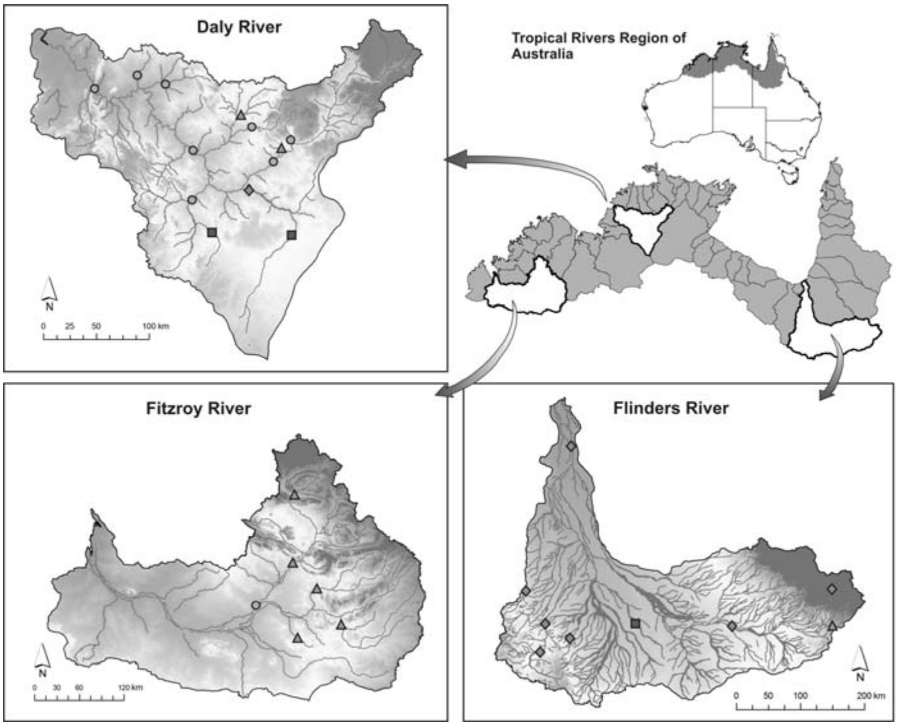


**Figure 3.22** Tropical rivers region showing the location of the Daly, Fitzroy and Flinders River catchments. Stations were classified in Section 2 as follows: perennial (○), seasonal (△), dry seasonal (◇) and seasonal-intermittent (□).

Between them, these three river catchments have 28 gauging stations with at least 20 years of complete annual runoff data (Figure 3.22). A selection of hydrology variables was derived for each of these 28 long-term stations. Multivariate cluster analysis of five independent hydrology variables was then used to identify groups of streams with similar flow regimes.

The analysis broadly grouped streams into (1) perennial, (2) seasonal, (3) dry seasonal, and (4) seasonal-intermittent systems. The coefficient of variation of total annual flow and the mean annual number of zero flow days were the two most influential variables for classifying streams into flow regime groups. Since the combination of these two variables explains 94% of the flow regime pattern it is considered that they may be acceptable for classifying the flow regime of streams within the wet-dry tropics. However, many streams throughout the region have little or no flow data available for such analysis, so another method needs to be developed to assign flow regime type.

A selection of basic, independent catchment characteristics (mean annual rainfall, and the topography-related variables of mean catchment slope, mean elevation and drainage density) were derived for each long-term station within the three focus catchments. Using standard multiple regression analysis, significant relationships were found which linked the two most influential hydrological variables, coefficient of variation of total annual flow and mean annual number of zero flow days, to these catchment characteristics. Cluster analysis of these predicted hydrology variables indicated that, by using the topographical characteristics and rainfall regime data, streams could be grouped into the same four classes as derived above using detailed flow records.

The results indicate that the use of catchment characteristics to predict hydrology variables (coefficient of variation of total annual flow and the mean annual number of zero flow days) is an acceptable technique to broadly estimate the flow regime of an ungauged stream within the wet-dry tropics. Additional stations with long-term flow data located within the wet-dry tropics, but outside of the Daly, Fitzroy and Flinders River catchments, should be used to further validate this technique.

### 3.11.3 Sub-project 2: Assessment of the major pressures on aquatic ecosystems

The objective of Sub-project 2 is to develop a risk assessment framework applicable to both the broad northern tropical rivers region (TRIAP area) and to a more detailed catchment scale. The broad northern Australia overview of the major pressures and threats on tropical Australia's aquatic ecosystems is based on data gathered during this Sub-project and Sub-project 1. The main aim of this component is to identify and describe the key threats, and their relative risks, to aquatic ecosystems. This will be done at a comparatively coarse level, using a catchment scale relative risk model first described by Landis and Wiegers (1997).[2]

Throughout this sub-project a wide range of stakeholders has been consulted to provide primary input and feedback on the development of the framework and aspects and impacts of threats. Semi-quantitative and quantitative risk analyses will be undertaken, where possible, for selected threats.

The risk assessment at focus catchment scale will utilise the same relative risk model applied at the broader overview scale. However the primary assessment unit will be at the sub catchment level. Further more detailed semi-quantitative and quantitative risk assessment is being undertaken for selected pressures and threats for selected sub catchments in the Daly River catchment. A conceptual model (see Figure 3.23) examining the impacts of native

[2] Landis WG & Wiegers JA 1997. Design Considerations and a Suggested Approach for Regional and Comparative Ecological Risk Assessment. *Human and Ecological Risk Assessment* 3, 287–297.

vegetation clearance and associated land use on ecological endpoints such as barramundi, magpie geese and riparian vegetation has been produced with input from key stakeholders.

A Bayesian Belief Networks (BBN) framework is being developed to undertake the risk analysis for this model (Cain 2001).[3]

An ecological risk assessment GIS is being developed utilising data collected under Sub-project 1 in the context of assets. Further spatial data relating to such impacts as land clearing and land use are being acquired and collated as pressures and threats. The GIS has a hierarchical structure based on asset, pressure/threat and scale (TRIAP area or focus catchment and associated sub catchments), and is crucial to the application of the spatially based relative risk model that is being used to characterise risk.

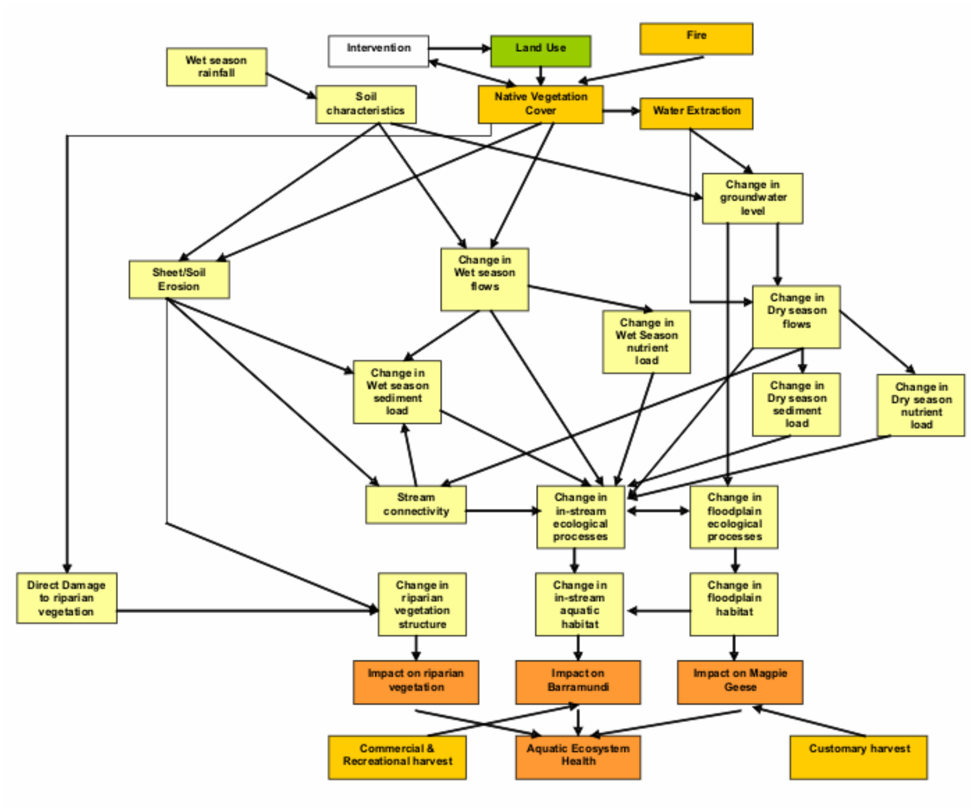


**Figure 3.23** Draft conceptual model for impacts on selected endpoints due to native vegetation clearance and associated land use in the Daly River catchment

3 Cain J 2001. *Planning improvements in natural resources management. Guidelines for using Bayesian networks to support the planning and management of development programmes in the water sector and beyond.* Centre for Ecology and Hydrology, UK.

### 3.11.4 Communications and stakeholder engagement

Key activities that have taken place to support the development of the risk assessment model include stakeholder workshops in two of the focus catchments (Fitzroy and Flinders), the completion and distribution of a risk assessment framework and methodology paper, and the development of several conceptual models for the focus catchments, depicting the inter-relationships between the ecological assets and threats.

Project linkages and communications with stakeholders have continued. Sub-project 2 team members participate in monthly meetings to discuss cross-project collaborations with other groups (Charles Darwin University; the Northern Territory Department of Natural Resources, Environment and the Arts; and CSIRO Northern Australia Irrigation Futures) working on tropical rivers projects. A linkage that has formed from these meetings is with a Daly River fish project being conducted by Charles Darwin University. The Bayesian Belief Network being developed through this sub-project will be utilised by the fish project.