European Cooperation in the field of Scientific and Technical Research - COST -

Brussels, 24 May 2013

COST 013/13

MEMORANDUM OF UNDERSTANDING

Subject :	Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action ES1304: European network on invasive parakeets: Understanding invasion dynamics and risks to agriculture and society (ParrotNet)

Delegations will find attached the Memorandum of Understanding for COST Action ES1304 as approved by the COST Committee of Senior Officials (CSO) at its 187th meeting on 15-16 May 2013.

MEMORANDUM OF UNDERSTANDING
For the implementation of a European Concerted Research Action designated as

COST Action ES1304
EUROPEAN NETWORK ON INVASIVE PARAKEETS: UNDERSTANDING INVASION DYNAMICS AND RISKS TO AGRICULTURE AND SOCIETY (PARROTNET)

The Parties to this Memorandum of Understanding, declaring their common intention to participate in the concerted Action referred to above and described in the technical Annex to the Memorandum, have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 4154/11 "Rules and Procedures for Implementing COST Actions", or in any new document amending or replacing it, the contents of which the Parties are fully aware of.

2. The main objective of the Action is to; (i) help understand invasion success of parakeets; (ii) harmonize research methodologies to enable prediction of their impacts across Europe; (iii) create a virtual European Monitoring Centre (EMC); (iv) transfer results to policy and society.

3. The economic dimension of the activities carried out under the Action has been estimated, on the basis of information available during the planning of the Action, at EUR 48 million in 2013 prices.

4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.

5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated from the date of the first meeting of the Management Committee, unless the duration of the Action is modified according to the provisions of Chapter IV of the document referred to in Point 1 above.

A. ABSTRACT AND KEYWORDS

The rose-ringed parakeet is listed amongst the top 100 worst alien species in Europe, and since the 1970s has rapidly established itself in over 100 cities across the continent and beyond. They have begun to pose problems in urban and rural areas such as disturbance to humans (including potential to transmit diseases to livestock and humans), competition with native wildlife and, increasingly, as an agricultural pest, already prompting changes in national policies. Worryingly, farming practices that adapt to global climate change and a warmer Europe facilitate the continued expansion of parakeet populations, amplifying the problems parakeets pose for European agro-economy. More generally, a temporal, spatial and social perspective of biological invasion is crucial to address, understand and solve the 'alien species problem' but is lacking. This Action will help to (i) better understand why some species such as parakeets are highly successful invaders, (ii) harmonise methodologies to predict agricultural, economic, societal and ecological impacts across Europe, and the means to mitigate them, (iii) create a virtual European Monitoring Centre for all invasive parrot species, and (iv) transfer results to policy and society. The Action fulfils EU 2020 Biodiversity Strategy, Convention on Biological Diversity and Syracuse Charter recommendations on invasive species.

Keywords: Invasive alien species, rose-ringed parakeet, impact on agriculture and society, environmental-economic risk, human welfare.

B. BACKGROUND

B.1 General background

Invasive Alien Species (IAS) present an increasingly urgent economic, societal and environmental problem. Europe experiences an annual economic impact from IAS estimated at €12.5-20 billion, of which € 9.6 billion can be attributed to damage (e.g. to infrastructure and health sectors). IAS are stated as one of the five main causes of global biodiversity loss in the 2005 Millennium Ecosystem Assessment, alongside climate change, pollution, overexploitation and habitat loss. The EU's 'Biodiversity Strategy to 2020' is the main instrument for meeting the challenges posed by IAS, which are likely to threaten European ecosystems and the services they provide in Europe. Consequently, European countries are obliged to tackle IAS problems and EU/international legislation sets out substantial expectations. For example, the United Nations (UN) Convention on Biological Diversity (CBD) expects countries to "eradicate those alien species which threaten

ecosystems, habitats or species", whilst the Bern Convention on the Conservation of European Wildlife & Natural Habitats requires members to "strictly control the introduction of non-indigenous species". Consequently, there is an urgent need for pan-European coordination to resolve the problem of IAS. Indeed, this urgency stimulated the European Commission (EC) to draft the policy document 'Towards an EU Strategy on Invasive Species' (COM (2008) 789 final).
To achieve pan-European coordination in order to tackle IAS, considerable investment has been directed towards the development of web-based multi-species IAS databases such as DAISIE (Delivering Alien Invasive Species Inventories for Europe), NOBANIS (European Network on Invasive Alien Species), GISD (Global Invasive Species Database), GBIF (Global Biodiversity Information Facility), *REABIC (Regional Euro-Asian Biological Invasions Centre)*, ESENIAS (East and South European Network for Invasive Alien Species) and the ISC (Invasive Species Compendium). These information-systems provide a comprehensive IAS resource for environmental managers and policy-makers. However such 'one-size-fits-all' resources are of limited scope for understanding and predicting invasion by particular IAS, their impacts and the means to mitigate them, especially when accurate prediction demands the integration of natural and social science approaches which often differ significantly between species. Yet, the EUs 'Biodiversity Strategy to 2020' specifically promotes interdisciplinary approaches to solving the IAS problem, approaches which are likely to be the only means of tackling the world's worst IAS.
Remarkably, a total of 13 alien species of parrot are established in Europe, and amongst these the rose-ringed parakeet (hereafter 'parakeet') has been identified by International Union for Conservation of Nature (IUCN) as amongst the top 100 of the world's worst alien species, invading Europe in the past few decades from their warmer native range (India and Africa). They now present a considerable risk to Europe's agricultural economy, society and wildlife. They are established in areas right across the continent (and beyond, as far as Mauritius and Seychelles), with recent evidence of explosive population growth in some regions of Europe. For example, parakeets colonised the UK in the 1970s from a few escaped pet birds; now they are the UKs fastest growing bird population, numbering >32,000 individuals. In Europe, it has now begun to pose problems to society such as noise disturbance (particularly in urban areas), displacement of wildlife, human health risks and increasingly as an agricultural pest. These problems have prompted changes in policy to minimise the impact of these birds. For example, parakeets can now be legally shot the UK; keeping parakeets as pets is now prohibited in Spain; and the species is black-listed by the Nature and Parks Authorities in Israel.
Wider relevance of the Action: Biological invasions can be catastrophic to society and the environment. Consequently they feature near the top of most government environmental policies.

Indeed, the EC has developed a dedicated legislative instrument on invasive alien species (EU 2020 Biodiversity Strategy). Parakeets pose a number of risks to Europe's economy and society, which worryingly are likely to increase as global climate change creates a warmer Europe. First, they pose a risk to agriculture. Farming practices will increasingly have to adapt to warmer climates; for example, maize, pecan nuts and sunflower will become more popular crops as mean temperatures rise. Parakeets are widely documented as being a pest of these crops, reducing maize yields by up to 81% in their native range. Furthermore, parakeets raid and cause significant damage to orchards and vineyards, sectors also set to expand as climates warm and which already note significant parakeet damage. Therefore, climate-driven expansion of parakeet populations across Europe will place increasing pressure on the economy. Second, parakeets pose a disease risk. These birds have the potential to transmit notifiable diseases to livestock and humans, such as psittacosis ('parrot fever' in humans, which is the primary cause of abortion in sheep), Newcastle's Disease and avian influenza. Their capacity to do so may increase as their populations grow in size and density (they can form very large roosts, providing opportunities for widespread disease transmission). Nevertheless, calls for culling are often unpopular: many people like having green parrots in their cities/gardens, regarding them as a harmless ornament. Therefore, parakeets attract both strong public support and concern, representing a complex socio-environmental conflict. The Action will therefore provide a major advancement in evaluating the factors shaping invasion success and will help place the EU at the forefront of invasion biology and global change research. Delivered management strategies will enable the EU to more effectively mitigate threats of the 12 other invasive parrot species and other similar avian IAS.

Why is COST the most appropriate framework?

1. Whilst substantial investment has been made in development of web-based multi-species IAS databases (see above), these types of general information-gathering systems are poorly positioned to deliver bespoke solutions for specific IAS. Furthermore, data are not always standardised across such resources (for example, at one point, information on the parakeet's IAS status featured differently in NOBANIS compared to DAISIE). The most problematic IAS, such as the parakeet, requires an approach that circumvents these limitations by ensuring data are comparable, to support the integration of information across various spatio-temporal scales. In general, a more species-specific approach is required to prompt changes in policy to minimise the impacts of IAS. For example, understanding the complex interactions between people and parakeets is essential to promote sustainable policy and these relationships could vary within and between countries and among different stakeholders. The Action is therefore essential to develop this approach for the parakeet which can then be applied to other invasive parrots and ecologically similar avian IAS.

2. Substantial research is being conducted on parakeets, but there is a surprising lack of cohesion between national research groups which is stalling progress towards tackling this, and other, IAS. For instance, understanding which factors limit distribution, abundance and population growth rate of parakeets is being pursued very differently between groups, including understanding the evolutionary origins and genetic diversity, population monitoring, landscape/habitat structure, and seasonal/climatic variation. The Action will facilitate crucial flow of information between different researchers to help systematically harmonise methods and identify/fill knowledge gaps.

3. A crucial priority is to harmonise research methodologies and data collection protocols between countries. For example, the task of understanding whether or not invasive parakeets have adapted their ecology is being tackled very differently amongst researchers, including studies on niche adaptation, breeding biology and morphology. The Action will facilitate harmonisation of methods and protocols, to enable research groups to synthesize these data.

4. There is an urgent need to up-scale and coordinate research efforts focused on measuring the impacts of parakeets on European wildlife, agriculture, economies and society. To date, much of this research has utilised small-scale study systems. For example, impacts on native birds have been assessed only in some parts of one EU country. Although important individually, these studies are inherently difficult to generalise, particularly for the parakeet which is so widely distributed. Crucially therefore, the Action will facilitate a much-needed landscape-scale approach.

B.2 Current state of knowledge

The recently adopted EC Communication on "Our life insurance, our natural capital: an EU biodiversity strategy to 2020" (COM (2011) 244) set a specific target to address the issue of IAS and proposes a dedicated legislative instrument (listed under Action 16) to tackle the problem. Towards this goal, researchers in Europe are addressing the ‘parakeet problem’ in many different ways.

Relevant ‘state-of-the-art’ research within the EU: Research on population size and spatial and temporal patterns of spread show that most parakeet populations are growing exponentially and spreading primarily across human-dominated areas. However, the drivers of this process are not well understood, hindering predictions of future range expansion, in the face of climate change which is likely to have a substantial influence on parakeet reproductive success; parakeets adapt their breeding time in response to climate, altering nesting sites to cope with prevailing conditions. Moreover, parakeets have expanded their realised niche into climates not occupied in their native range, hampering forecasts of invasion risk. Current research investigates whether morphological

adaptations can explain such niche shifts. Although geneticists are characterising evolutionary patterns of invasion, more knowledge on parakeet genetics is crucial to understand their invasion success. Damage to agriculture and infrastructure is increasingly reported anecdotally, but no standardized databases of quantified data at the landscape level of these claims exist. Finally, research examining how parakeets are perceived by city dwellers and farmers and how they impact on human psychological well-being is underway. Importantly, however, these efforts urgently require coordination if the problems parakeets cause are to be effectively addressed at the EU level.

Relevant research worldwide: The Action will build upon previous EU-funded projects such as DAISIE and NOBANIS. The global invasion of parakeets has also forced countries beyond Europe to begin to tackle this issue. For example, a recent EC-funded project is supporting IAS management in the Indian Ocean where parakeets have recently colonised.

Innovation to address an urgent problem: To address the parakeet problem requires networking scientists and practitioners from a vast range of disciplines, from evolutionary genetics and agro-economics to the social sciences, demanding innovative creativity that arises only through interdisciplinary networking. Consequently, the Action will facilitate a highly interdisciplinary approach to IAS to produce policy-relevant science. In doing so, the Action will add value by building upon previous EU-funded projects such as those under the 6th and 7th Framework Programmes (e.g. DAISIE, NOBANIS, ALARM), as well as providing important momentum for current schemes on IAS (e.g. 2012-13 BiodivERsA).

B.3 Reasons for the Action

Research activities on parakeets have, so far, been isolated from one another, limiting any scope for wider synthesis to address the parakeet problem across Europe and beyond. The use of multiple methods makes it difficult to harmonise approaches across the EU landscape. Consequently, results cannot be generalised and knowledge gaps cannot be easily identified and filled. Therefore, current efforts to characterise agro-economic and societal impacts (and to forecast risks) of parakeets across Europe and the means to mitigate them are severely compromised. More broadly, a spatial, temporal and societal perspective of invasion is sadly lacking, but is crucial to address, understand and solve the ‘alien species problem’. The Action will tackle these complex interdisciplinary issues for the parakeet and thereby develop an approach for dealing with the 12 other invasive parrot species recently established in Europe. The Action will strengthen Europe’s scientific networking capacity in IAS in relation to the European Research Area, and will fulfil key objectives of the EU 2020 Biodiversity Strategy (and more widely, Europe 2020) and will stimulate novel research for

EU-level instruments such as Horizon 2020.

Advancing science and meeting European socio-economic needs: To address the problems that parakeets pose to society and the environment (see B. 1), the Action will unify (i) scientific approaches to studying parakeets and their ecological impacts and (ii) important socio-economic and social science methodologies aimed at measuring human perceptions of parakeets and impacts on society. This dual framework provides a novel interdisciplinary approach to a complex problem.

B.4 Complementarity with other research programmes

By consolidating up-to-date information on parakeets, the Action will make all information available to (and will therefore complement) existing EU-funded projects such as DAISIE, NOBANIS and other initiatives including GISD, GBIF, REABIC and ESENIAS. The Action will also precipitate and support projects that emerge from recent Pan-European calls on invasive species including the BiodivERsA call on "Invasive Species and Biological Invasions". The Action complements (rather than duplicates) current Actions targeted at pest management such as FP1102 (DIAROD, Determining Invasiveness And Risk Of Dothistroma) by providing an interdisciplinary ‘blue-print’ solution for integrating information on priority avian IAS.

C. OBJECTIVES AND BENEFITS

C.1 Aim

The aim of the Action is to: (i) help understand why parakeets are such successful invaders; (ii) harmonize research methodologies in order to enable prediction of agricultural, economic, societal and ecological impacts and the means and constrains to mitigate them across Europe; (iii) create a virtual European Monitoring Centre (EMC) for monitoring the parakeet and other invasive parrot species, and; (iv) transfer results to policy and society.

C.2 Objectives

Objective 1: Define and quantify the current impacts of parakeets on European agro-economy, society and wildlife and also evaluate the social and ecological feasibility of different policies aiming to reduce those impacts. This information will help create evidence based recommendations for management solutions at different legislative, spatial and EU policy levels. For example, recommendations could vary from pan-European to local mitigation measures.

Objective 2: Create a virtual EMC to monitor spread of parakeets and other invasive parrot species in order to predict future impacts on European agro-economy, society and wildlife and characterise *'risk-profiles'* involving scenario-based projections to make EU-level policy recommendations.
Objective 3: Integrate all available evidence to determine what factors limit distribution, abundance and population growth rate of parakeets across Europe, in order to inform policy. For example, if pet escapees are shown to be a driving factor then national/EU pet trade restrictions may be needed.
Objective 4: Integrate all available evidence to establish extent and nature of evolutionary change by parakeets and prioritize utility of information for predicting future invasion pathways, in order to evaluate their response to climate change across the EU landscape.

C.3 How networking within the Action will yield the objectives?

Objectives 1-4 of this Action will be achieved through concerted, collaborative efforts of experts across different disciplines including evolutionary genetics and ecology, invasion biology, socio-economics, agriculture and the social sciences, all sharing a common interest in IAS and in particular invasive parrot species in Europe. The Action will offer a unified platform for **stimulating high-quality outputs** and will stimulate research across Europe, enabling successful coordination of national activities into an integrated pan-European project through **regular meetings** (physical meetings supplemented by additional skype/video-conferences). The network plans to connect with teams from further countries in Europe and beyond. **Short Term Scientific Missions** (STSMs) and **Training Schools** will be organised in order to train Early-Stage Researchers in key activities and skill-sets such as demographic modelling (dynamic models), molecular DNA tools, landscape-level spatial analyses and data management. **Outreach activities**, **dissemination of knowledge**, and **transfer of 'know-how'** are an important part of this Action and will be implemented through scientific meetings, workshops, and conferences. A key activity of the Action will be the establishment of a **dedicated project website** which will be directly linked to the online virtual EMC. The website will act as a forum for discussion for researchers and a platform of knowledge with relevant links. It will also be used for announcement of events and a call for additional participations will be announced there.
Direct involvement of stakeholders: The Action Management Committee (MC) and Working Group (WG) Leaders will liaise directly with relevant European projects and initiatives, including DAISIE, NOBANIS, GISD, GBIF, REABIC and ESENIAS, to ensure maximal knowledge exchange. Beyond these projects, the Action will actively engage with additional resource groups including the European Environment Agency (EEA) and the European Commission's Shared

Environmental Information System (SEIS), the European Alien Species Information Network (EASIN), the Group on Earth Observations Biodiversity Observation Network (GEO BON), the Invasive Species Centre (ISC) and the IUCN Invasive Species Specialist Group (IUCN ISSG). Action networking activities will additionally embrace these resource groups in the form of presentations given by Action participants (aligned with STSMs where possible) at linked conferences, seminars and national science fairs.

C.4 Potential impact of the Action

Considerable work remains to be done to meet Target 5 of the EU Biodiversity Strategy 2020 (which also mirrors Target 9, Strategic Goal B of the CBD Aichi Targets) for the parakeet and other invasive birds. The Action will support this proposal in the following ways;

1. The Action will provide substantial momentum and advocacy for fulfilling this EU strategy and elevate European capacity for tackling the problems posed by the parakeet, a species listed by DAISIE amongst the top 100 worst IAS (see section B.1).

2. Provision of capabilities for evaluating agro-economic, societal and ecological impacts across Europe (Objective 1) will benefit Europe's farming industry (estimated to comprise 14 million farmers) and help minimise further damage to Europe's ecosystem and the services they provide (most of which are judged to be 'degraded' by the European Environment Agency). The Action will also highlight means to mitigate those impacts and explore their ecological and societal limitations to promote an evidence-based policy. To maximise impact, the Action will liaise directly with/invite key policy officers associated with the EC Common Agricultural Policy.

3. Action Objective 2 (creation of the virtual EMC) will provide a crucial resource for evaluating impact of parakeets on human and animal health (see section B.3). To maximise impact, the Action will liaise directly with/invite key participants from the European Environment Agency and the EC 'Agriculture and Environment' policy area.

4. Knowledge exchange and harmonisation of research methodologies to understand the invasion pathways and impact of parakeets (Objective 3 and 4) will benefit academic and environment sectors and provide much-needed clarity for policy-makers (see section B.2).

5. The Action will provide the means to ensure data and status of the parakeet are standardised across existing information-systems and will provide a model framework for pipelining and disseminating detailed information on specific IAS.

6. A total of 12 other non-native parrot species have established smaller but nonetheless self-sustaining populations in Europe, any or all of which could become invasive in the very near future.

The Action will provide a ‘blue-print’ solution for tackling these other potential IAS.

7. Development of a template that practitioners and policy-makers can apply to tackle other IAS (especially other avian IAS), thereby fulfilling Target 5 of the EU 2020 Biodiversity Strategy.

8. The EMC will also provide a public focus and research portal for a pan-European ‘citizen science’ initiative that has been developed and successfully piloted in the UK to engage the public in collecting up-to-date geo-referenced data on parrot distribution (for monitoring rate of invasion) and feather samples (for genetic and disease analyses). The EMC will therefore assist with transferring Action results to society (Objective 2) and in doing so will help fulfil the European Environment Agency’s call for a ‘global public information service’.

9. The Action will enable public opinion of parakeets to be surveyed in order to understand the public’s relationship towards them, and to what extent such engagement might influence people’s perceptions of this IAS. Policy-makers will thus be better informed of subtle social complexities.

C.5 Target groups/end users

The Action will provide information and synthesis of data to a diverse range of end-users and stakeholders, including national and EU government officers, the European farming community, environmental economists, scientists, policy-makers, landscape planners, NGOs, key decision-makers and the general public. The Action will be particularly relevant for: (i) informing European IAS policy by assisting decision-makers needing to formulate and justify IAS policy (e.g. EC staff tasked with the preparation and delivery of a dedicated legislative instrument on IAS (EC COM(2011)244)); (ii) assisting national IAS strategists and NGO consultants to implement IAS policy and meet EU Biodiversity Strategy 2020 and CBD Aichi Targets; (iii) engaging and educating the general public on IAS issues by providing a clear message on impact of parakeets. Web-based and PR activities will assist with gauging public perceptions and informing about impacts, and; (iv) enabling updating of information-systems such as SEIS, EASIN, and ISC.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

Policy rationale: Europe experiences an annual economic impact estimated at €12.5-20 billion as a consequence of IAS, a global issue defined in the 2005 Millennium Ecosystem Assessment as one of the five main causes of global biodiversity loss. The EU Biodiversity Strategy to 2020 is the main European instrument for meeting the challenges posed by IAS, which are likely to threaten

native biodiversity and delivery of Europe's ecosystem services. Consequently, European countries are obliged to tackle IAS problems, with EU/international legislation upholding substantial expectations. There is therefore a clear need for pan-European coordination to tackle IAS.

Limitations of existing tools: Whilst web-based multi-species IAS databases and information-systems provide a comprehensive IAS resource for policy-makers, such 'one-size-fits-all' resources are of limited scope for understanding and predicting invasion by particular IAS. Although multi-species, web-based inventories such as DAISIE, NOBANIS, GISD and GBIF allow identification of general drivers of invasion success (such as patterns in international trade, and anthropogenic modification of ecosystems), the spatial and temporal resolution of the information contained in these databases is generally not sufficient to determine what exactly drives the invasion of particular troublesome IAS, or to rigorously assess their impact on native biodiversity, the economy, human health and well-being. This restriction is especially true for many IAS such as the parakeet where achieving this goal demands an interdisciplinary approach.

Pan-European coordination: Substantial research is being conducted on parakeets but there is a lack of cohesion between national research groups. There is a need to harmonise research methodologies and data collection protocols between countries (http://ec.europa.eu/environment/integration/research/newsalert/pdf/273na4.pdf), and to up-scale and coordinate research efforts focused on measuring the impacts of IAS across diverse sectors.

Development of a 'species-level' solution: To address, understand and solve the 'alien species problem' a 'birds-eye' view across time, space and disciplines at the species level is crucial but is sadly lacking. To tackle these complex interdisciplinary issues for the parakeet, this Action will help to (i) understand why parakeets are such successful invaders, (ii) harmonise research methodologies in order to enable prediction of agro-economic, societal and ecological impacts and the means and constraints to mitigate them across Europe, (iii) create a virtual EMC to track and predict spread of parakeets and other invasive parrot species, and (iv) transfer results to policy and society.

Wider application: The Psittaciformes (parrots) are one of the most invasive of bird families; 12 other parrot species have established smaller but nonetheless self-sustaining populations in Europe, any or all of which could become invasive. Indeed, the Monk parakeet, from South America, is already becoming highly invasive across parts of Europe. Fortunately for invasion biology, the multiple independent invasions of the rose-ringed parakeet across Europe provide unusually robust analytical opportunities to understand impacts and devise mitigation measures that can be fed back into policy. Consequently, the parakeet is a "model species" to test hypotheses about invasion success, spread, impacts, the means and constraints to mitigate those impacts and the outcomes can

then be applied to other parrot populations if/as they become a problem.

The Action will liaise directly with relevant European initiatives, including DAISIE, NOBANIS, GISD, GBIF, REABIC and ESENIAS, to ensure maximal knowledge exchange. The Action will provide an interdisciplinary 'blue-print' solution for housing information on particular IAS and providing a means to predict future impacts. Consequently, the Action will provide substantial momentum and advocacy for fulfilling the EU 2020 Biodiversity Strategy and will elevate European capacity for tackling the problems posed by IAS.

Human and technical means: Scientific research of relevance to the Action objectives is currently being approached from various perspectives and using a variety of different methods.

Research relevant to Objective 1 is being conducted by research teams using experiments to quantify disruption of native birds, and by other researchers to evaluate broader agro-economic aspects. To date, much of the research by different teams on impacts of parakeets has been developed across many localised study systems. The Action will facilitate synthesis of these data and up-scaling to a landscape-scale approach (for example, to quantify the impact of parakeet damage to high-value agricultural land covers such as vineyards/orchards and extensive coverage crops such as maize/sunflower).

The substantial collective research by the Action participants will contribute towards Objective 2 with the intention of informing future EU policy in the face of different scenarios of parakeet spread and climate-driven land-use change.

Regarding research relevant to Objective 3, researchers are quantifying molecular genetic diversity, conducting roost-counts, analysing national breeding bird survey data and surveying human perceptions of parakeets. Elsewhere, scientists are examining landscape structure and feeding ecology, and measuring seasonal/climatic variation in reproductive biology. Teams in several European countries are examining parakeet spread in relation to habitat variability, and in relation to pet trade records to estimate impact of accidental releases on parakeet spread. To meet Objective 3, these data will be synthesized alongside published findings to define population limiting factors.

Research relevant to Objective 4 currently involves examining adaptation of parakeet ecological niche from their native to invasive range, quantifying adaptive changes in breeding biology across climatic gradients and looking for evidence of morphological adaptation. The Action will identify important knowledge gaps and develop strategies to fill them, and prioritize utility of information for predicting future invasion pathways.

D.2 Scientific work plan methods and means

The work plan of the Action comprises four Work Packages (WP) (comprising a total of 13 primary tasks) with responsibility for each allocated between four Working Groups (WGs). Each WG will lead activity for a particular WP but collaboration with the other WGs and the Action Management Committee (MC) will ensure effective coordination and efficient delivery of objectives and milestones.

WG1: WP1 - Impacts on society/economy/environment, and public perception (Objective 1)
Impacts of parakeets will be quantified with regard to their effects and potential effects on European agro-economy, society and wildlife. Data sets will be compiled from published and unpublished sources, including from agricultural, human health, environmental and socio-economic sectors and will where possible be integrated into a geo-spatial framework that will be aligned with parakeet distribution and density maps. To examine public perception that could influence both invasion success and the feasibility of mitigation efforts, WG1 will compile published and unpublished data on social perception of parakeets. Methodologies will be harmonized to enable valid comparison of people's perceptions of parakeets across countries and cultures. WG1 will also evaluate to what extent these perceptions may limit the efficiency and impact of mitigation programs and identify whether education campaigns could potentially reduce public objections to such programs. WG1 will comprise Action participants (particularly spatial modellers, ecologists and environmental social scientists), other expert contributors, and officers from relevant European Commission policy areas such as the 'Agriculture and the environment' policy area.
Task 1: Identify main categories of potential impact spanning both natural and social science areas and evaluate quantity and quality of information available.
Task 2: Harmonise data sets and approaches used to quantify parakeet impacts. Develop protocols and propose pan-European standardised methods for data collection and synthesis. Identify key gaps in data and allocate STSMs accordingly (linking to WG3 and WG4).
Task 3: Assess actual and expected impacts of parakeets on agricultural, human health, environmental and socio-economic sectors at national and European scales and evaluate to what extent public perception may constrain actions. Where possible, spatial and temporal trends in impacts will be quantified (Task 2 and 3 linking to WG2).
Milestone 1: Produce schematic flowchart identifying main categories of impacts informed by data evaluation and key knowledge gaps.
Milestone 2: Propose standardised methods for data collection; STSMs allocated and implemented.
Milestone 3: Publish trends in parakeet impacts and circulate to stakeholders, database managers and EC officers.

WG2: WP2 - European Monitoring Centre (Objective 2)

A virtual EMC will be created for monitoring spread of parakeets and the other alien parrot species established in Europe and predicting their future impacts on European agro-economy, society and wildlife. This Centre will facilitate characterisation of *'risk-profiles'* at both national and European scales to inform key EC policy areas such as 'Agriculture and Environment', 'Climate Change' and 'Rural Development'. The Centre will develop and produce scenario-based projections of parakeet spread and subsequent impacts, and will formulate key recommendations for IAS policy. WG2 will comprise database managers of existing IAS online resources, web resource developers, natural and social science experts and conservation planners.

Task 1: Identify core datasets and data types (from WG1 and WG3) required to effectively monitor change in parrot distribution, density and impacts.

Task 2: Explore innovative approaches to analysing trends and patterns of parrot spread that integrate measures of impact, and compare suitability of different existing IAS platforms for use by EMC (linking to WG1). Identify and align STSMs accordingly.

Task 3: Develop EMC as integrated online resource building upon and integrating parrot data from DAISIE, ISC, NOBANIS and GISD repositories.

Task 4: Develop and propose standardised approaches to predict future impacts by parrots, and formulate key recommendations for IAS policy-makers.

Milestone 1: Summarise core datasets required for long-term monitoring and measurement of impacts.

Milestone 2: Compare different approaches for analysing trends and prioritize most appropriate IAS platforms.

Milestone 3: Combine available data from existing information-systems with updated parrot information.

Milestone 4: Publish and present through EMC predictions of future impacts of parrots at different spatial (local, national, pan-European) and temporal scales.

WG3: WP3 - Drivers of population distribution and growth (Objective 3)

All available evidence regarding factors determining parakeet distribution, abundance and population growth rate across Europe will be reviewed. For this review information (spatial and temporal) will be drawn from multiple sources, including current IAS and biodiversity-related information-systems, and data from published/unpublished reports. The review will also incorporate information from the native range of parakeet, and from other areas outside Europe where it is also

an invader. WG3 will comprise Action participants (particularly with expertise in demographic and ecological modelling), data providers and database managers, national scientific and other expert contributors including from the IUCN ISSG and EC.

Task 1: Conduct systematic review of existing information and data in terms of data type, quality and geographic coverage. This process will involve thorough interrogation of all existing IAS-relevant information systems for parakeet data (including databases not in the public domain), alongside consultation with relevant expert contributors from IUCN ISSG, ISC, NOBANIS and GISD.

Task 2: Prioritize utility of data for informing essential demographic parameters and identify important data gaps that need filling. STSMs will be targeted to address data/knowledge gaps, following input from Action participants (demographic and ecological modellers) and expert contributors.

Task 3: Synthesize accumulated data sets (to include initially those on climate, land-use, habitat availability and diversity, genetic diversity and evolutionary origin) and explore temporal and spatial patterns to identify factors limiting parakeet population distribution and growth across Europe (linking to WG1).

Milestone 1: Report on parakeet data in existing information-systems and recommend key analyses.

Milestone 2: Recommend data/studies required to fill knowledge gaps and align to STSMs.

Milestone 3: Publish analysis identifying limiting factors.

WG4: WP4 - Evolutionary change and prediction of invasion (Objective 4)

All available evidence will be reviewed including current research and datasets, to establish extent and nature of evolutionary change by invasive parakeets in response to novel environments. Utility of different data types will be evaluated and prioritised for predicting future invasion pathways. WG4 will comprise Action participants with expertise in molecular genetics and all aspects of evolutionary ecology and invasion biology, together with other scientific and academic expert contributors.

Task 1: Review available evidence for adaptation by parakeets, set in context of climate change, environmental disturbance, urbanisation and agricultural land-use change across Europe (linking to WG3).

Task 2: Evaluate and compare utility of different data types for detecting signals of adaptation. Identify important gaps in knowledge and datasets and allocate STSMs accordingly (linking to WG3).

Task 3: Harmonise priority datasets across national boundaries, summarise and set results in context of environmental and anthropological change.
Milestone 1: Report on evidence for adaptation
Milestone 2: Protocols developed for harmonisation of national data sets and STSMs aligned.
Milestone 3: Publish findings on evidence for evolutionary change by invasive parakeets.

E. ORGANISATION

E.1 Coordination and organisation

The Action will be coordinated by the MC established in compliance with the document "Rules and Procedures for Implementing Actions". The MC will comprise the Chair, Vice-Chair, WG Leaders, STSM managers and up to two members per country, all of whom will be nominated and elected at the first Action meeting. The MC will meet every two months via Skype/video-conferencing, with regular email contact augmenting these meetings. The MC will be responsible for the planning and delivery of the Action including liaison with the local organisers responsible for hosting WG meetings. A support committee will be assigned to each meeting to assist the local organiser in logistical arrangements and production of key meeting outputs.
To achieve objectives 1-4 Action activities will be organised and managed across the four-year period as four work packages (WP 1-4), each of which will be assigned a WG (WG 1-4) that will meet twice a year (comprising up to two members/country) and will have overall responsibility for leading one of the four objectives. A dedicated Action-specific website will form a major basis for delivery, management and dissemination of key Action documents and datasets. The website will be regularly updated following WG meetings and this resource will also be integrated with the online platform housing the virtual EMC, thereby attracting additional participation and networking from external researchers.

E.2 Working Groups

Four WGs will comprise the main focus of Action activities, orientated around each of Objectives 1-4, with strong lines of communication and collaboration between them to ensure close coordination, balanced workload and an interdisciplinary perspective.
WG1: Impacts on society/economy/environment and public perception (Objective 1)
WG2: European Monitoring Centre (Objective 2)
WG3: Drivers of population distribution and growth (Objective 3)

WG4: Evolutionary change and prediction of invasion (Objective 4)

Each WG will lead on specific COST activities, being directed by a nominated WG Chair (elected at 1st meeting) who will be responsible for delivery of WP objectives and reporting to the MC (comprising up to two members per country) that will also meet physically twice a year.

Monitoring and evaluation of progress towards objectives: The WG Leaders will have responsibility for ensuring networking activities adhere to a specified timetable and they will report each month to the MC Chair to ensure progress across the Action. WG tasks and milestones will be set in a detailed schedule that will be reviewed by the MC and WG Leaders at WG meetings.

Each WG will organise two workshops or conferences which will focus on topics central to each WP to maximise networking opportunities with key stakeholders. Each of the four WGs will allocate and manage two STSMs each year, and returning researchers will deliver a presentation and circulate a report to the WG and MC to further facilitate knowledge exchange and networking between all participants and stakeholders including policy-makers. COST participants will travel between research groups in Europe to conduct these STSMs, with an emphasis on knowledge exchange, skill-sharing, method-harmonizing, capacity-building and mobility of junior European researchers. Early-Stage Researchers will be actively encouraged by WG Leaders to take up these STSMs.

E.3 Liaison and interaction with other research programmes

The Action MC and WG Leaders will liaise directly with relevant European projects and initiatives, including DAISIE, NOBANIS, GISD, GBIF, REABIC, ISC and ESENIAS, to ensure maximal knowledge exchange. Beyond these projects, the Action will actively engage with additional resource groups including the EEA, EASIN, GEO BON and the IUCN ISSG. Action activities will additionally embrace these resource groups in the form of presentations given by participants (aligned with STSMs where possible) at conferences, seminars and national science fairs (MC and WG meetings will, where appropriate, be scheduled to coincide with relevant international IAS meetings).

E.4 Gender balance and involvement of Early-Stage Researchers

Early-Stage Researchers will be actively encouraged to engage in Action activities and to benefit from STSMs and training workshops scheduled as part of WG meetings. The MC and WG Leaders will be responsible for ensuring that all Early-Stage Researchers are prioritised for STSMs, that

they give presentations to the WG on their return and that they receive feedback from the WG members on their role. All Early-Stage Researchers on STSMs will be mentored by a WG member (nominated by the WG Leader) to help with capacity-building and development of their skills-base and research portfolio.

Equality of opportunity: All participants in the Action are committed to promoting equality of opportunity for both male and female Early-Stage Researchers. Over 25% of the current participant list is female. In order to achieve an equitable gender balance, the Action will particularly encourage females to participate overall, to serve on the MC, and to lead WGs and workshops. Each listed participant is committed to encouraging and supporting the career progression of females already in their research team and to favourably view applications, from females, for all of Early-Stage Researchers. As far as possible, women will be equally represented on WGs and the MC.

Involvement of Early-Stage Researchers: The Action is also committed to substantially involve Early-Stage Researchers, including PhD/MSc students in the final years and Early-Stage Researchers at Post-Doctoral level. Again, this item will be included as a standard item on all MC Agendas. This Action will include STSMs and Training Schools to engage Early-Stage Researches and to develop the next generation of researchers to create and maintain a lasting tradition of European excellent in this field. Particular attention will also be given to promising young researchers who will be encouraged to develop and take up STSMs for an extensive exchange of knowledge between different research communities, and in doing so to create their own personal career profile at an international level. Early-Stage Researchers will be encouraged to become a WG leader or member of the MC (where appropriate) or to deputize in order to gain experience in research leadership.

In addition to the opportunities for Early-Stage Researchers supplied with STSMs, workshops and Training Schools will be organized during the last year of the Action. These will be intended for disseminating knowledge, methodologies and results in order to supply large numbers of young researchers with new skills for their specialization and growth in a collaborative context and to enhance their networking capacity.

F. TIMETABLE

TABLE 1: The total duration of the Action is 4 years. The timetable of activities by WG 1-4 in relation to the Action objectives and tasks is detailed below (approximate scheduling of milestones for each WG; STSMs will be scheduled according to availability of Early-Stage Researchers and the host participants; the precise timing of workshops/conferences will be scheduled to maximise

value and impact for the Action; F, final conference to disseminate final outputs);

ParrotNet	**Year-1**				**Year-2**				**Year-3**				**Year-4**			
Quarter	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
MC meetings	X		X		X		X		X		X		X		X	
WG1 (Task 1):	X	X	X	X	**1**	X										
WG1 (Task 2):				X	X	X	X	X	X	**2**						
WG1 (Task 3):								X	X	X	X	X	X	X	X	**3**
WG2 (Task 1):	X	X	X	X	**1**											
WG2 (Task 2):				X	X	X	X	X	X	**2**						
WG2 (Task 3):	X	X	X			X	X	X	X	X	X	**3**	X	X		
WG2 (Task 4):													X	X	X	**4**
WG3 (Task 1):	X	X	X	**1**	X											
WG3 (Task 2):					X	X	X	X	**2**							
WG3 (Task 3):							X	X	X	X	X	X	X	X	**3**	X
WG4 (Task 1):	X	X	X	**1**												
WG4 (Task 2):				X	X	X	X	X	X	X	**2**					
WG4 (Task 3):									X	X	X	X	X	X	X	**3**
STSMs		X		X		X		X		X		X		X		X
Conferences			X		X		X		X		X		X		X	F

G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: BE, BG, DE, EL, ES, FI, FR, IL, IT, NL, PT, UK. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 48 Million € for the total duration of the Action. This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.

H. DISSEMINATION PLAN

H.1 Who?

The Action will provide the highest quality information on parakeets to the following target audiences to ensure maximum dissemination of the results;

European-level policy makers: Findings will be disseminated to EU policy-makers at all relevant levels via submission of reports and direct communication with offices such as the EC officers associated with EU IAS policy, the EU Biodiversity Strategy 2020, those involved with emerging legislation (for example, policy recommendations stemming from COM (2011)244) and to the European Centre for Nature Conservation and the European Commission's 'Science for Environmental Policy' News Service.

National Government policy-makers and regional planners: National IAS policy-makers and National Scientific Advisors to governments will be directly consulted throughout the Action and invited to WG meetings to give feedback on key findings.

Non-governmental organisations (NGOs), Research Institutes and Academia: Findings will be disseminated to key NGOs in the fields of biodiversity and agro-environment as well as national and European institutes, in order to ensure greatest impact of all publications and outcomes.

Biodiversity managers and practitioners: National bodies and NGOs working in the arena of biodiversity will be encouraged to engage with and follow progress being made by the Action, through online membership to web/email updates via the dedicated Action website.

National ornithological and conservation societies: Such organisations frequently have large memberships, reach lots of people and are instrumental in forming public opinion about IAS. Consequently, these organisations will be actively sought and engaged with and summaries of key findings widely disseminated.

General public (including schools): The distinctive looks and gregarious nature of parakeets makes them instantly recognisable to the Public, attributes well-suited to encouraging engagement in dissemination activities and in 'citizen science' schemes linked to the Action. The Public's wide-ranging attitudes to parakeets will also ensure high levels of interest in Action outcomes and deliverables. All key outcomes and findings will be summarised in layman terms for distribution to the Public via press releases and supplemented by web downloads from the dedicated Action website. For example, the EMC website will include lay summaries for non-scientists.

H.2 What?

Alongside the extensive use of the more traditional methods of dissemination, such as the Action website, wide circulation of Action reports and publications, and direct consultation with policy-

and decision-makers at regional, national and EU levels, the Action will also utilise modern methods, including social media, to embrace broad public participation via 'citizen science' schemes associated with the Action (see section C.4).

Website: The Action website will be the focal point for disseminating information on progress, outputs and key findings. Layman summaries written in easily-digestible formats will also be published there.

Annual reports: Formal reports will be produced each year by the MC summarising progress and findings from WGs, and distributed to key decision-makers. Feedback will be encouraged from all stakeholders via the Action website.

Email network: A series of email networks centred round core topics (defined by Action WGs) will be developed and used to circulate reports and web-links to new Action updates to a wide spectrum of interested parties.

Information packs and factsheets on parakeets: Given the fragmented nature of information on parakeets that is currently contained across numerous online IAS databases, these data will be consolidated and presented in laymans language as information packs for the general public.

Peer-reviewed publications: The participants on this Action have a strong track-record in publishing their findings on IAS in high-quality peer-reviewed scientific journals, which will serve as a common standard for dissemination of all Action outputs.

Conferences linked to WGs: Each WG will organise two workshops or conferences on topics central to each WP. Conferences will be designed to maximise networking opportunities and knowledge exchange with key stakeholders and policy-makers.

Training workshops/STSMs: Workshops by each WG will include a training component and these activities will be augmented by the STSMs. Each STSM will include at least one dissemination activity such as a presentation or seminar open to the general public.

Internet-based social media: These outlets, including Twitter and Facebook, will be used in order to communicate the Action findings to large sectors of the general public, as well as mailing lists to reach interest groups such as the many online birding groups with extensive membership.

Smart technology: To capitalise on the Public's fascination with parakeets, the feasibility of developing smartphone applications ('apps') about the parakeet will be explored (for example, similar to 'PlantTracker'; http://planttracker.naturelocator.org/). These will be linked to the EMC to provide a means for the Public to contribute parrot observations, geo-referenced photos, etc.

Press Releases: Press releases will be coordinated by the MC in close liaison with relevant COST Office staff and press offices of key participant institutions, in order to ensure that news of key findings are disseminated efficiently to mainstream national and international news media.

H.3 How?

Monitoring and evaluation: The MC will delegate responsibility to two nominated members for development and monitoring of the delivery of a 'Dissemination Plan' for the Action. The Dissemination Plan will be regularly reviewed and updated by the MC in relation to progress of the Action. As part of the annual report at the end of the penultimate year, the MC will present to the DC a revised Dissemination Plan for approval. The Final Evaluation Report will review the Dissemination Plan in close consultation with the DC.

Website and EMC: The exposure of the Action website will be maximised via links to the EMC, appropriate use of social media such as Twitter and Facebook, and geographically widespread promotion of the 'citizen science' schemes directly associated with the Action.

Multinational expertise: An overall core outcome will be production of multi-authored publications in high impact peer-reviewed journals. The development of the Action has already identified a potential network of several international professional scientists and researchers (both academics and practitioners) that together span a diverse range of natural and social science disciplines including invasion biology, demographic and ecological modelling, natural resource management, biodiversity conservation, wildlife disease, social policy, anthropology and spatial planning. Collectively, individual members of this potential network have produced numerous high-impact publications, demonstrating strong potential synergies and ability to deliver objectives.

Interdisciplinarity: This Action will transcend the traditional boundaries of scientific research, an essential requirement in order to tackle the 'parakeet problem'. Parakeets in Europe represent a complex socio-environmental conflict; they attract strong public, political and environmental concern given their potential for widespread and diverse negative impacts, but they are regarded favourably as harmless ornaments by many sectors of the general public. Consequently, the MC will ensure the Dissemination Plan remains open and sensitive to how the Action is perceived by different sectors of society.

Public engagement: Interactive web-pages on the EMC will disseminate up-to-date information on presence/absence and spread of all invasive parrots across Europe (it is also intended to explore feasibility of spatial information on impacts). In addition, on-going 'citizen science' schemes running since 2010 in the UK (to collect feathers for DNA analysis; counting at roost sites; and garden experiments) will be expanded across Europe, encouraging members of the Public to get involved with the research/associated issues (http://www.wildparakeetsuk.co.uk/; *www.projectparakeet.co.uk/*). These schemes have gathered considerable momentum via social

media and are now primed as high-profile public education tools.