

Aboriginal and Torres Strait Islander Astronomy

Working Group - Australian Astronomy Decadal Plan

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1. Executive Summary and Recommendations

This decadal plan is the first time in focusing and incorporating **Aboriginal and Torres Strait Islander astronomy**. **It is not a 10-year process, but the start of a long-term relationship building effort**. Building on previous outreach and education efforts, it emphasizes deepening relationships with Indigenous communities and integrating traditional knowledge into research.

The last decadal plan highlighted the importance of Indigenous knowledge in astronomy education, acknowledging how Aboriginal and Torres Strait Islander peoples have used astronomy for navigation, calendars, and social structures. However, progress has been slow in fully integrating these perspectives.

A large fraction of the community wants to expand their involvement - in research, practice, and reconciliation. Many respondents collaborate with Indigenous communities, publish works integrating cultural and scientific knowledge, and co-teach courses on Indigenous astronomy. However, **barriers such as limited funding, insufficient institutional support, and intellectual property concerns hinder further progress**.

Most institutions have **Cultural Action Plans (CAPs)**, but only a few are at the department level. Some have focused on cultural safety, Indigenous research, and increasing representation. CAPs emphasize the need for ongoing cultural competency training and the integration of Indigenous knowledge into organizational policies and research.

Indigenous research methods, such as **yarning** and **Country as method**, prioritize relationships and respect for the land. Collaborative efforts between astronomers and Indigenous elders offer valuable insights into historical celestial events and astronomical phenomena.

Educational initiatives, such as **Indigenous work experience program** and the **National Indigenous Science Education Program (NISEP)**, aim to engage Indigenous youth in astronomy. These efforts, along with university-led **cultural astronomy courses**, are essential for fostering Indigenous participation and creating pathways into astronomy research. **Ensuring continuous staff education on Indigenous knowledge systems remains key to long-term success**.

Key Recommendations

1. An Australian Astronomy Cultural Action Plan and Committee / Advisory Body

While CAPs are throughout the organizational level, a community-wide one will help support common goals, and a committee to measure and oversee progress will make sure any plan is implemented, and adapted as the community grows. ASTRO3D's advisory body is one example of how such implementation can support change.

2. Recognition of Indigenous Knowledge and Knowledge Systems as a complement, not subservient, to Western Methods

When often talking about Indigenous knowledge systems and methods, it is often viewed as a separate endeavor than methods our community is more familiar with. However, the two methods and systems are equal, and can, and do, support each other's goals. **Recognition in ARC grants, promotions, FTE, and other system-based approaches will elevate Indigenous methods to their rightful place - as equal.**

3. Funding for Hiring Strategies and Targets

To increase the current numbers of Aboriginal and Torres Strait Islander with PhDs in Astronomy - 2 - specific measures to address this are needed. Schemes like the **ANU Indigenous Research Associate - which pays and treats Indigenous students as postdocs** while allowing them to complete their PhD over 5 years - can and will drive change. Specific targets, like at CSIRO, **will keep our community accountable. We have already seen such effects when goal-oriented programs are implemented, like ASTRO3D achieving 50/50 F/M astronomers.**

4. National support for engagement with Elders and Communities

Relationship building does not happen overnight. It will take time, in the case of **ICRAR, CSIRO, and the SKA - over 15 years**, to build trust. Long-term support - funding and FTE - to build relationships with some of the other 300 language

groups is crucial. **This strategy is similar to engagement with Industry - an iterative process of mutual beneficial needs and cooperation.**

5. Incorporating Aboriginal and Torres Strait Islander Astronomy into university courses

Some universities are starting to run courses for undergraduates that at least have sections or components of Cultural Astronomy. **All introductory courses should at least have this,**

6. Training for our community

This will not happen overnight. Continued education - such as short online courses and professional training bodies like through AIATSIS - **will grow our community. These will also give goals and strategies** to increase awareness and incorporation of traditional knowledge systems and methods, **a commonly quoted barrier.**

2. Previous Decadal Plans

This is the first decadal plan there is a dedicated working group, focused on Aboriginal and Torres Strait Islander astronomy. The last decadal plan incorporated this area into WG 3.2 - Outreach and Education. There, a few recommendations were made.

The previous report highlighted the importance of integrating Indigenous, Aboriginal, and Torres Strait Islander knowledge and perspectives into Australia's astronomy education and outreach efforts. It acknowledges the rich cultural heritage of Indigenous astronomy, particularly how traditional knowledge systems have been used for navigation, calendars, and social structures.

There was a growing focus on incorporating these perspectives into educational materials and public engagement programs, ensuring that Indigenous voices are represented in the broader conversation about astronomy.

The WG report also stressed the need to engage Indigenous youth in astronomy, aiming to inspire their interest in science and research. By involving Aboriginal and Torres Strait Islander students in outreach programs, one could foster a greater connection between traditional knowledge and modern scientific exploration.

Not many other science fields have decadal plans that meaningfully, or dedicated, incorporate Indigenous knowledge systems. The last decadal plan in biology emphasizes the need to deepen relationships with Indigenous peoples and integrate traditional knowledge into research and conservation practices. In the **immediate term (1-3 years), goals include training staff to**

incorporate Indigenous knowledge into collections and research, though no long-term goals are clearly outlined. The research aims to benefit from and support First Nations in areas such as Traditional Ecological Knowledge, Caring for Country, and cultural heritage. It stresses the importance of ongoing relationships between institutions and Indigenous communities to inform practices related to cultural significance, consent, and benefit-sharing. Additionally, there is a clear need to train the workforce in integrating Indigenous knowledge and recognize Indigenous peoples as key stakeholders in research and institutional decisions.

However, national bodies, such as the Australian National Curriculum, and the office of the Chief Scientist, have taken steps to incorporate and promote more Indigenous Knowledge and Knowledge Systems.

3. Individual and Institutional Surveys

18 people currently engage in Aboriginal and Torres Strait Islander, Indigenous, or Cultural Astronomy research or research methods. More promising, **206 people expressed an interest in engaging more in these methods.**

A significant focus of those identified as working in this space is in collaboration **with Indigenous communities**, with one example highlighting a 15-year partnership between researchers and the Indigenous communities of the Mid West of Western Australia, facilitated through Yamaji Art in Geraldton.

Many of those who responded are involved in **publishing works** that integrate cultural knowledge with astronomical research. They are involved in ongoing **research projects, often in collaboration with Indigenous artists and researchers**, or through liaison with **elders** using oral traditions as a source of data and knowledge. There are also researchers on with the **Square Kilometre Array (SKA) project, working with traditional owners to ensure Indigenous land and knowledge are respected.**

Some participants **co-teach courses on Indigenous astronomy** while others have hosted **Indigenous research internships/scholars**. Public engagement, aiming to educate the broader public on the significance of **Indigenous astronomy**. In addition, several respondents expressed a deep **curiosity and desire to learn** more about Indigenous astronomy,

Responses by Institutions are incorporated into later sections, such as Cultural Action Plans, but a number of barriers were mentioned. Despite investments, many have struggled to establish successful engagement or develop a sustainable pipeline of Indigenous students. **Funding and insufficient resources** are ultimately what is limiting the expansion of these programs. Additionally, **there is often a lack of institutional support, with some universities not fully recognizing the value or business case for such initiatives. Intellectual property concerns** also present challenges, particularly in aligning **Indigenous intellectual property rights with university policies on teaching materials and research, making it difficult to**

fully integrate Indigenous knowledge into academic settings. These barriers collectively hinder the growth and success of Indigenous-focused educational programs and educational materials.

4. Cultural Action Plans

The vast majority of institutes reported that they had in place Cultural Action Plans (CAP)s, only three of these had them at the department/institution level. The majority have them at the parent level of the organisation (i.e. university-wide).

For instance, U Sydney's Reconciliation Action Plan (RAP) emphasizes creating a culturally safe environment through initiatives such as **Indigenous research collaborations and mandatory cultural competency training for staff.** The university supports Indigenous students through scholarships, mentoring programs, and tailored academic support. Partnerships with Indigenous communities are a cornerstone of the plan, reflecting a broader institutional commitment to reconciliation.

Queensland's RAP is focused on building strong, **long-term partnerships with Indigenous communities.** This includes offering cultural awareness training for all staff and students and creating more pathways for Indigenous students to access higher education. The university actively engages with local Indigenous communities to co-create projects and guide its approach to research, education, and community engagement, ensuring that these partnerships are central to the university's operations

Monash's Indigenous Action Plan prioritizes increasing Indigenous representation in both staff and student populations. This includes an Indigenous Employment Strategy to hire more Aboriginal and Torres Strait Islander staff and embedding Indigenous perspectives into the curriculum. Cultural safety programs ensure that Indigenous students and staff feel supported, while initiatives to promote Indigenous knowledge-sharing across faculties further integrate these perspectives into the university's culture.

U Melbourne follows a dual approach with its RAP and IAP, both of which aim to elevate **Indigenous voices and integrate their knowledge across the university's teaching and research.** The plan supports Indigenous researchers by **offering funding and development opportunities and incorporates Indigenous knowledge into leadership programs.**

At the heart of a CAP is the recognition and integration of Indigenous knowledge. These plans encourage organizations to acknowledge the rich cultural systems of Indigenous people and ensure that this knowledge is embedded into organizational decisions, especially in areas like research, education, and policy-making. CAPs also emphasize building cultural competence among staff, equipping them with the knowledge and skills necessary to engage respectfully and effectively with Indigenous communities.

Forming genuine partnerships with Indigenous communities is key along with mechanisms for ongoing accountability, with regular reviews and evaluations to ensure that the plan is continuously improving and remains relevant to the community it serves.

Looking at some of the parent level organisations CAPs, there are aims to engage with Indigenous communities, increase awareness and representation, and engage in Indigenous research methods. However, as reported by a number of individuals and institutions, knowing how to engage and next steps is lacking.

An Australian Astronomy Reconciliation and Indigenous Action Plan, built out of the decadal plan, will support institutes and individuals bring about change.

Leaders within the organization must demonstrate a commitment to cultural safety and respect, making it a priority at all levels. Cultural Action Plans should also be tailored to fit the specific context of the organization. The CAP must reflect how the organization interacts with Indigenous people and cultural knowledge in its daily operations. This tailoring ensures that the plan is both relevant and practical for the organization.

Ongoing cultural competency training is another crucial element of a successful CAP, with regular training on Indigenous history, cultural protocols, and ways of knowing. This training should not be seen as a one-off event but as part of a continuous learning process that helps staff build and maintain their cultural competence.

Setting clear, measurable goals is vital for ensuring the CAP's success. These goals provide a way to track progress and hold the organization accountable for its commitments. Goals could range from increasing Indigenous employment, to integrating Indigenous knowledge into key programs, to implementing cultural safety policies across the organization.

For a CAP to be effective, it must be embedded into the organization's policies and procedures. This could include adjusting research ethics guidelines, hiring practices, and how projects are managed, to ensure that cultural safety is a priority in every aspect of the organization's work.

It is also important to allocate adequate resources to implement the CAP. This includes financial support for cultural competency training, community engagement, and the development of Indigenous-led initiatives. **Without proper funding, even the best-designed CAPs can struggle to achieve their goals.**

Finally, a CAP should be seen as a living document, one that evolves as relationships with Indigenous communities deepen. Regular reviews, feedback from Indigenous stakeholders, and adaptation ensure that the plan remains effective and relevant over time.

5. Research and Facilities

Indigenous research methods are rooted in the traditions, knowledge systems, and cultural practices of Aboriginal and Torres Strait Islander peoples. These methods prioritize relationships, respect for the land, and the interconnectedness of all living things, with the principles of **Caring for Country**. According to AIATSIS (Australian Institute of Aboriginal and Torres Strait Islander Studies), research in Indigenous communities must begin **with meaningful consultation and collaboration with Elders and Traditional Knowledge Holders**.

The first step in conducting Indigenous research is establishing trust and building relationships with Elders and traditional knowledge holders, **who are the custodians of cultural knowledge**. AIATSIS guidelines emphasize the importance of engaging Elders from the outset to ensure that **the research aligns with community values and priorities. This often involves visiting communities, listening to their needs, and respecting their ways of knowing**. Researchers should ask for permission to access Indigenous knowledge and ensure that any **data collected is used to benefit the community**.

Free, prior, and informed consent is paramount. Researchers must obtain consent from Indigenous communities before any research begins, and this consent must be ongoing, meaning that the community can withdraw its support at any time. **This approach helps protect Indigenous intellectual property rights, ensuring that knowledge is shared in a way that respects cultural protocols**.

An essential part of this process is **collaboration**, where Indigenous communities are actively involved in shaping the research questions, methodologies, and outcomes (i.e. papers). This may involve co-designing research projects with Indigenous partners, rather than imposing external academic frameworks. Collaborative research allows Indigenous knowledge systems and Western systems to be integrated together, rather than dominated by a western-led approach.

Indigenous research methodologies differ from Western scientific approaches - they are relational and holistic, focusing on the interconnectedness of people, land, and the cosmos. One key method is **yarning**, a conversational approach used to gather information in a culturally appropriate way. Yarning sessions are informal discussions where participants share stories and knowledge, and they are particularly effective for engaging with Elders and community members.

Another important approach is **Country**, which involves recognizing the land as a source of knowledge. Research is conducted in relation to the land, emphasizing the responsibility to care for it and respect its spiritual significance.

In addition to yarning and Country as method, **storytelling** plays a central role in Indigenous research. Stories are a traditional way of transmitting knowledge, and they often contain deep insights into many areas of sciences - including astronomy. Engaging with Indigenous stories can provide valuable data for researchers, but it is crucial that these stories are treated with respect and used only with permission from the knowledge holders.

However, there are many other areas beyond Archaeoastronomy. Remnants of astronomical transients, such as supernovae, that were witnessed centuries ago, recorded through both written and oral traditions, offer invaluable data for astronomy. Examples include Egyptian records of Algol and its variability, as well as the **Kolkatha people of South Australia who measured star variability.**

Observations of subtle changes in the environment and rare transient events are well described in oral tradition, including stellar variability. Collaborations with elders is leading to new research that reveals characteristics that can guide astrophysical practices. These include oral traditions about transient phenomena, such as eruptive and pulsating variable stars, that provide details about the event that can be useful for guiding observations. These details include brightness, longevity of appearance, location in the sky, etc. This information has proven vitality in oral tradition for millennia, some as long as 10,000-15,000 years. By collaborating with elders and Aboriginal communities, we will be able to open thousands of years of discovery.

Chinese records of a supernova in Scorpius, SN393, and Yolngu traditions that align with these observations. Indigenous oral histories, such as those of the Boorong people in Victoria, offer unique insights into celestial events like the Great Eruption of Eta Carinae. The collaboration between astronomers and Indigenous Elders will utilize these cultural records to guide historical research into transient phenomena.

There is a fascinating connection between Indigenous astronomy and modern radio astronomy. Aboriginal and Torres Strait Islander people have long used the twinkling of stars for navigation and weather prediction (Hamacher 2019) and Wardaman elder Bill Yidumduma Harney). In parallel, modern astronomers are using high time resolution observations from instruments like ASKAP and MWA to study radio wavelength twinkling, or Interplanetary Scintillation (IPS), to predict space weather. This highlights one of the many parallels between Indigenous knowledge and cutting-edge scientific research.

6. Increasing Aboriginal and Torres Strait Islander Representation

Only a handful of Aboriginal and Torres Strait Islanders have been awarded advanced (Masters and PhD) degrees in astronomy-related fields, and even fewer are permanently employed in the field.

Programs aimed at Indigenous high school and undergraduate students across Australia have been implemented, in some cases for over a decade, and while numbers of Indigenous PhDs and academics and other science fields increases, astronomy has not seen the same level. An emphasis on increasing programs aimed at Aboriginal and Torres Strait Islander postgraduates and academics is key.

CSIRO's S&A Innovate RAP Implementation Action Plan involves strategic actions to implement Reconciliation Action Plans within **CSIRO, with specific targets on employment and representation.**

ICRAR runs the Renu Sharma Scholarship for Women and Indigenous Students Summer Studentships, supporting these groups into post-graduate pathways.

The Indigenous Academic Associates Program at ANU aims to foster a robust community of Indigenous researchers and academics, as outlined in its Strategic Plan and Reconciliation Action Plan. By creating a structured career pathway, the program aims to support emerging Aboriginal and Torres Strait Islander scholars in completing their PhDs while gaining valuable academic experience.

The program offers full-time employment at the **Academic Associate Level A, with 60% of their time to their PhD studies and the remaining 40% to academic duties within their School.** This structure ensures that associates can effectively balance their research and academic responsibilities, contributing to their School's research, education, and outreach efforts. The position is specifically reserved for Indigenous Australians, who must either be enrolled in or eligible for enrollment in a relevant ANU PhD program aligned with their School's research focus.

The role involves ensuring the academic workload is manageable and allows ample time for PhD research. Supervisors are responsible for guiding the associate and approving research and professional development expenses.

This is a university-led initiative, as part of the parent organisation RAP, but **ANU currently has 2 astronomy students on this program,** who will be finishing in the next few years (and are part of this WG). **This allows a competitive salary to outside industry jobs, and the recognition of extra duties Indigenous students are often asked to shoulder.**

Of note, Australia is not the only country trying to address inequalities and under representation of Indigenous communities. In South Africa, the National Astrophysics and Space Science Programme (NASSP) in South Africa, which has been instrumental in training South African and African astronomers.

The National Astrophysics and Space Science Programme (NASSP) is a multi-institutional initiative funded by the DSI-NRF to train South African students in astrophysics and space science at the Honours and Master's levels, with a pathway to PhD studies in these and related fields. Established in 2003, the program operates across three nodes: the University of Cape Town, the University of KwaZulu-Natal, and North West University. Over 300 students have earned Honours degrees and more than 140 have completed Master's degrees through NASSP. Its mission is to empower South African and African students to contribute to globally recognized research and knowledge creation in astrophysics and space science.

A similar model could be beneficial in Australia to improve Indigenous representation in astronomy.

7. Education

Education is multi-faceted - programs to support Aboriginal and Torres Strait Islanders, formal university education for all students, and self-education of our community.

Several astronomy outreach and education programs exist across Universities and organisations.

For example the Gravity Discovery Centre (GDC) in Gingin hosts weekly storytelling events led by Aboriginal Elder Dr. Noel Nannup and other members of his family, where they share Indigenous constellations and creation stories.

ASTRO3D and ANU have developed an Indigenous work experience program that is designed to cater to the specific needs of Indigenous students interested in astronomy. Since 2022, ASTRO-3D has conducted pre- and post-program evaluations to better understand student motivations and outcomes. **The post-program feedback was overwhelmingly positive, with students expressing continued interest in Indigenous astronomy, STEM careers, and engagement with scientists.**

OzGrav focuses on long-term engagement with all-girls schools and regional schools, particularly those with a high percentage of Indigenous students. Similarly, ICRAR offers summer internships and work experience programs that prioritize Indigenous students, providing them with practical research opportunities. These programs are complemented by events such as Indigenous art exhibitions, astrophotography workshops, and the "Star Dreaming Full Dome Show," which combines Indigenous sky stories with modern astronomical science.

The National Indigenous Science Education Program (NISEP) **takes a holistic approach to supporting Indigenous students through high school and into tertiary education. With a focus on inclusion and equity, NISEP's initiatives include science demonstrations in local schools, Indigenous student leaders as demonstrators, and university campus tours. Designed in consultation with Indigenous Elders,** this program emphasizes ethical engagement and collaboration, providing a supportive framework for Indigenous students to thrive in STEM fields.

Universities are now running Aboriginal and Cultural astronomy courses. **Melbourne is now running a full undergraduate program with four courses focusing on Cultural and Indigenous astronomy that are open to all students, not just science students.** ANU has incorporated this as well as part of one of its first-year courses, aimed at all undergraduate students.

Cultural and Reconciliation Action Plans are underpinned by the desire to keep educating oneself. **While many organisations have mandatory cultural awareness courses, these can often be seen as a tick box exercise, and relying on these to constitute change can limit progress.**

Many universities and organisations offer courses, including online courses, for education on Indigenous research and research methods. Examples such as **UTS's Supervising Indigenous HDR students and QUT's Indigenous Perspectives in Learning & Teaching** are designed to be interactive, in-depth, and flexible with professional's schedules. These options, and others, offer continuing ways to grow knowledge, methods, and awareness of issues and practices for those wanting to engage in Indigenous research methods.