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| GROVER Scientific (E-DNA SAMPLER)AN ON PROGRAM CASE STUDY |
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| grover Scientific (e-DNA Sampler) case study - executive summary |
| Key findings* Grover Scientific has developed a low cost, compact, lightweight (less than two kilos), robust e-DNA sampling device.
* The device is easy to use and does not require a high level of technical skill.
* The product can be carried in a backpack and has a lightweight, efficient solar/battery power supply.
* Demand for the sampler from researchers and organisations has been good despite very limited effort at marketing.
* Growth in the use of e-DNA sampling as a tool should drive economic, health and environmental benefits.
* The net present value (NPV) of participation in the ON program was estimated to be $2.5 million under a 7 per cent real discount rate, while the benefit-cost ratio (BCR) is 7.1.

Role played by CSIRO ONThe ON program was very helpful in helping Grover Scientific to commercialise their e-DNA sampling technology. Their participation in the ON program was also helpful in helping the research team to improve the design of their products and standardise the manufacturing process. In the absence of the program it is highly unlikely that the technology would have been commercialised. |
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This case study uses the evaluation framework outlined in the CSIRO Impact Evaluation Guide. The results of applying that framework to the Grover Scientific case study are summarised in Figure 1.

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| Figure  1 grover Scientific case study – IMPACT FRAMEWORK |
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| **INPUTS** | ▶ | **ACTIVITIES** | ▶ | **OUTPUTS** | ▶ | **OUTCOMES** | ▶ | **IMPACTS** |
|  |  |  |  |  |  |  |  |  |
| * Support from CSIRO New Ventures Services ($45,000)
* ON Program support ($288,480)
* JCU Bridging the Gap grant ($30,000)
* In-kind support from JCU
 |  | * Design & build prototypes
* Field trials in in Wet Tropics & PNG
* Marketing to research bodies and at international conferences
* Refined design to two core products
* Client survey
 |  | * Early adopters in Australia and in 12 overseas countries
* Improved product capability (battery performance, stackable reusable/disposable filtration pods)
* Overseas manufacturing explored
* Training videos
 |  | * Technology trialled in 18 countries
* New orders and repeat customers
* Online sales capability
* Direct sell at conferences
* Lean start up team structure
* Licensing explored
* Online sales presence
 |  | * Revenue from product sales
* Increased global capacity to monitor endangered species
* Reliable and affordable product enables collaboration at scale to address environmental issues
* Improved health outcomes
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| Source: acil allen |
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* 1. 1. Purpose and audience for case study

This case study describes the economic, environmental and social benefits arising from the GROVER e-DNA Sampler project.

This evaluation is being undertaken to assess the positive impacts arising from the Grover project’s participation in the CSIRO’s ON. This case study can be read as a standalone document or aggregated with other case studies to substantiate the impact and value of the CSIRO ON activities as a whole, relative to the funds invested in these activities.

The information in this case study is provided for accountability, communication and continual improvement purposes. Audiences for this report may include Members of Parliament, Government Departments, ON, CSIRO and the general public.

#### CSIRO ON

CSIRO ON was established in 2015 as a four year program by CSIRO to help accelerate the impact of science research into market (the program ends in June 2020). The initiative was expanded through funding from NISA to service more broadly Australia’s publicly funded researchers and their industry partners. The aim of the initiative is to more quickly translate great science and technology research into positive impact to help address some of the economic, environmental and social challenges facing the Australian and global community.

There are a number of elements to the program, including two facilitated programs, ON Prime and ON Accelerate. These two elements are designed to complement each other.

ON Prime is an open and collaborative program for existing science projects as well as new technologies and projects that are still in development. ON Prime helps research teams to ensure that they are working on the right problem, it provides frameworks to create and test assumptions about their idea and provide recommendations towards next steps. ON Prime can be considered as an entry level program, in effect it can be seen as a precursor to participation in the ON Accelerate program.

ON Accelerate is designed for teams that have made significant progress with their idea and their target market(s). This may be in the form of contracts for paid or unpaid trials, or at the most advanced stage, recurring sales with both new and existing customers. This implies that teams will have a working prototype of their product or service and have secured any appropriate intellectual property rights. It is expected that teams applying for ON Accelerate would have conducted significant engagement with their potential customers and be able to demonstrate what they learned throughout, including what the total addressable market is and what competition exists.

For ON Accelerate, shortlisted applicants are invited to participate in a two-day Selection Bootcamp event where teams will be provided with training and coaching simulating the accelerator experience. At the conclusion of the selection bootcamp, the teams will pitch to a panel of external judges for a spot in the Accelerator. Projects that are at Investment Readiness Level (IRL) Stage 3 can apply directly for ON Accelerate without going through Prime or Bootcamp.

Following a team’s passage through the ON Prime or ON Accelerate program they are eligible to apply for ON Runway support. That funding is designed to help teams to further progress their project. The support provided can be spent on a range of services, for example, regulatory certification, marketing, bookkeeping or investor agreements.

The program is expected to exceed its targets for participation. It is predicted that it will have reached 515 teams with over 1,850 people by the time it concludes on 30 June 2020.

* 1. 2. Background

There is a pressing need for more information on the health and biodiversity status of aquatic environments around the globe. Sampling especially in remote locations has been expensive and posed many resourcing, safety and logistical challenges. The absence of sampling capability that is cost effective and easy to use has hindered scientific progress and collaboration. The equipment available was bulky, heavy and expensive (over US$5,000).

The development of the Grover Scientific e-DNA Sampler combines two key capabilities. First it incorporates an innovative method to extract DNA directly from environmental samples from water bodies like rivers, oceans and lakes without having to catch the target organism. Second, the sampling is done by a low cost, small, lightweight (less than two kilos), robust product, that is easy to use and does not require a high level of technical skill. The product can be carried in a backpack; has a lightweight, efficient solar/battery powered sampler and 3D printed, stackable filtration pods that can either be decontaminated and re-used or be disposed of. The product can be produced for approximately $150 per unit. The technology offers the opportunity to greatly increase scientific knowledge through large scale collaboration of researchers in Australia and globally.

* 1. 3. Impact pathway
		1. 3.1 Project inputs

The total cost for the Grover project was about $318,480 million in cash and some $7,000 in-kind contributions (see Table 1). The ON program accounted for the majority of the cash contribution. Other cash contributions were from CSIRO’s New Ventures Services and a JCU Bridging the Gap grant. JCU also provided in-kind support through providing access to the JCU Innovation Centre for Manufacturing.

Table 1 support for the Grover Scientific project

| Contributor / type of support | 2018  | 2019  | 2020  |
| --- | --- | --- | --- |
| **Cash** |  |  |  |
| ON Accelerate | $225,000 |  |  |
| ON Runway  | $18,480 |  |  |
| CSIRO – New Venture Services |  | $45,000 |  |
| JCU-Bridging the Gap |  | $30,000 |  |
| **In-kind** |  |  |  |
| JCU |  | Use of JCU Innovation Centre for Manufacturing | Use of JCU Innovation Centre for Manufacturing |
| Accounting |  |  | $2,000 |
| Heather Robson  | $5,000 |  |  |
| **TOTAL** | **$248,480** | **$75,000** | **$2,000** |
| Source: acil allen |

* + 1. 3.2 Project activities

In 2014 Heather Robson was conducting research into invasive species (in particular an invasive fish called tilapia) at James Cook University (JCU) as a PhD student. She was making use of a recently developed sampling technique called e-DNA. This approach relies on collecting water samples in the field. Those field samples are then analysed in the laboratory to identify the presence of DNA from a particular target species whose DNA profile is known. This approach was a major advance over the previous sampling method of electro fishing, which required operators to stun the fish that are present in the water with an electric current and collect them with nets for visual identification.

Mrs Robson found that the commercially available equipment for collecting water samples was very large, heavy and not fit for purpose, particularly when it had to be used in remote and difficult to access parts of the country.

By 2017 Mrs Robson and a colleague from the JCU Innovation Centre with engineering and design expertise, Wayne Morris, had developed the first prototype of the Grover Scientific e-DNA sampler, which is now called the “Grover-Go”. It is a small easy-to-use solar/battery powered e-DNA sampling device that can be manufactured for approximately $150 and which weigh less than 2 kilos. They designed and built 4 prototypes and conducted preliminary field trials. Testing was undertaken on research projects in the Wet Tropics of Australia and in PNG. Examples of the equipment were also provided to other scientists working in the same field. This generated considerable interest and led to requests for a further 60 e-DNA sampling devices. The team at that point, had no ability to meet the growing demand for production of additional devices.

In 2018 the project team participated in the ON Accelerate program and with the support of that program, the researchers established Grover Scientific to market their technology. Grover Scientific used a matching grant from JCU and CSIRO to help pay for work to improve the design of the Grover-Go and to develop a more advanced prototype, the ‘Grover-Pro’. The grant also allowed Grover Scientific to refine the design of the filter pods to enable a move from 3D printing to injection moulding the pods. Work was also undertaken to make them more sustainable by exploring the use of compostable materials.

The support that Grover Scientific received enabled them to produce the devices needed to meet the demands of early adopters such as the Australian Institute of Marine Science (AIMS), CSIRO and the Save Our Seas Foundation.

###### Role of the ON program

The ON program was very helpful in helping them to commercialise the sampling technology. It helped to accelerate their path along the learning curve. One important decision was to adopt a trademark approach to the technology rather than seeking to patent it. The ON program was also helpful in helping the research team to standardise the manufacturing process. One of the team participated in a visit to China and the learnings from this are being applied to the manufacturing process.

* + 1. 3.3 Project outputs

There are currently some 75 Grover e-DNA samplers in use in 18 countries around the world. A further 100 have been built and are ready for deployment. Grover Scientific are currently getting an average of around five orders a month, many of these are repeat orders. The Grover e-DNA sampler is being used in conservation research and for detecting invasive species. For example, researchers are using the device to monitor critically endangered frogs, to detect the invasive fish species Tilapia, to study sharks (as a part of a global shark initiative) and to monitor fisheries in PNG.

AIMS is currently conducting a head-to-head comparison test of Grover Scientific’s e-DNA sampler and its competitors.

#### Publications

There have been limited publications, although several researchers are beginning to reference their use of the Grover technology in work that is currently being published, with approximately 15 in-press citations. An example of such a publication is:

* Edmunds, R.C., Cooper, M., Huerlimann, R., Robson, H., and Burrows, D. 2019. *Environmental DNA survey of Eureka Creek, Upper Mitchell, and Walsh River for invasive Oreochromis mossambicus and Tilapia mariae* (November 2017). Report 19/06, Centre for Tropical Water and Aquatic Ecosystem Research (TropWATER), James Cook University, Townsville

#### Patents

No patents have been applied for, rather Grover Scientific is protecting its IP through the use of a trademark, and trade secret.

#### Awards

Grover Scientific has not received any rewards for its technology.

#### Innovation / commercialisation

Following the initial field trials the focus was on enhancing the product’s capability to ensure an attractive offering that was a rapid, reliable, and portable environmental sampling device.

An online sales presence for Grover Scientific was established in early 2020 with two core product offerings, namely the Grover-Go (cost of manufacture is $190, they retail for $1,250) and the Grover-Pro (cost of manufacture is $200, they retail $1,500). The product is supported by a lean start-up team of five part-time personnel. There are no salaried employees.

Grover Scientific have surveyed their approximately 75 users to identify what they are using the samplers for. This information was used to assist users of their equipment by producing several training videos. Other innovations included improving ease of use in the field by developing injection-moulded filtration pods that can either be decontaminated and re-used or disposed of. In addition, Grover Scientific supplies a rugged case and a solar/battery power supply for the e-DNA sampling device.

The technology is sold with a one year warrantee. Most of the users of the equipment are Australian or overseas researchers. Grover Scientific have set up a system for returning any faulty products by mail. To date, only one device has been returned and the problem on that occasion proved to be user error. Grover Scientific is exploring potential arrangements for distributors in Europe and the US. However, sales volumes will need to increase before distributors can be signed up.

Grover Scientific has been contacted by representatives of the Townsville Council to investigate the use of the technology to monitor algal blooms and invasive water weeds. The University of Queensland is considering the use Grover Scientific’s e-DNA device to look for signs of the COVID-19 coronavirus in wastewater sewage.

###### Role of ON program

Grover Scientific estimates that they would have made a maximum of around 25 e-DNA devices if they had not participated in the ON program. A key benefit from that participation was a better understanding of how commercialisation and innovation works. For example, Dr Robson noted that:

ON teaches people how to commercialise an invention and to take something from a one-off custom build to a product you can consistently produce and sell to others.

* + 1. 3.4 Project Outcomes

An important outcome of the project is the development of two core commercial products, the Grover-Go and Grover-Pro, that are now commercially available and can be purchased online for $1,250 and $1,500 respectively. The number of products sold has slowly but steadily increased over time.

New uses for the technology are being explored, including as a way of monitoring wastewater to provide and early warning of any potential spike in corona virus infections.

Another important change is in the nature of the courses being taught at JCU. In 2020, a new offering, the Bachelor of Technology and Innovation was launched which incorporates the learnings from the ON program in their university courses. The course has numerous small innovation and start-up modules which can be accessed by both full-degree students and professionals in the region. Industry partners are being matched to further promote an innovation culture in North Queensland.

###### Role of the ON program

Participation in the ON program was crucial to the commercialisation of the technology. If the researchers had not participated in the program, then it is likely that only a vary small number of e-DNA sampling devices would have been made before the project was shelved.

Two of the mentors in the ON program have agreed to help deliver modules in the Bachelor of Technology and Innovation course at JCU as the program expands.

* + 1. 3.5 Adoption

The use of the GROVER e-DNA Sampler has increased over the two year period since the initial field trials despite a relatively low key marketing approach. There are competitors in the market for example the Smith Root backpack eDNA sampler.[[1]](#footnote-1) but this is six to seven times the cost of Grover Scientific’s product at $5,495 USD each. However, the Smith Root product has a patent pending whereas the Grover sampler is not IP protected.

There is a significant opportunity to scale up with the current price structure and potential market. The samples taken by the Grover Scientific product can be analysed to test for any number of species’ DNA. The amount of a species’ DNA in a sample also provides a measure of its abundance in the environment being tested. Thus, the application for sampling of aquatic populations has few limits. Customer market segments that have been identified as potential users of e-DNA testing equipment include researchers, environmental monitoring agencies, citizen science groups, the aquaculture industry and water supply agencies.

###### Role of the ON program

Grover Scientific’s participation in the ON program was crucial to their ability to manufacture and market their technology.

* + 1. 3.6 Impacts

The Grover’s combination of cost, portability and technology has enabled rapid uptake and progress on some major scientific projects. These include:

* JCU research into critically endangered frogs in the Wet Tropics, testing for the presence of the invasive Tilapia fish in Queensland, New South Wales, Western Australia, and fisheries in PNG.
* The Australian Government’s National Environmental Science Program (NESP), Northern Australia Environmental Resources Hub Project 4.3, *The Northern Australia eDNA Program – Revolutionising Aquatic Monitoring and Field Surveys in Tropical Waters*. The e-DNA sampling using the Grover Scientific devices has enabled the rapid testing of large areas of Queensland’s waterways at risk of infestations of this invasive fish.
* An AIMS Project to monitor the Crown of Thorns starfish. The Crown of Thorns Starfish is one of the major threats to the Great Barrier Reef, however outbreaks are not apparent until the adult stage. The juveniles are initially highly mobile, and the early sessile stage occurs in deeper water and again are very difficult to detect. Currently the most common method for detecting outbreaks are on-reef field surveys using divers. However, by the time these methods detect an outbreaks, it is usually well established, which has prevented timely intervention to control the outbreak. The e-DNA sampling method offers to opportunity to monitor populations, better predict and identify outbreaks and develop more effective control measures.
* The 2019 Save Our Seas “Global Sawfish Search” involves e-DNA sampling in 16 countries.[[2]](#footnote-2) The objective of the project is to research the current global distribution of sawfish using e-DNA survey techniques. Sawfish are considered the most threatened group of marine fish species, with all species on the IUCN Red List as Critically Endangered or Endangered. They are also listed by CITES and CMS. Sawfish have disappeared from many countries that made up their historic range because of overfishing and habitat loss. As a result of rapid population declines, sawfish are protected in many of their range states. The development of a global conservation strategy identified the need to clearly resolve where populations persist beyond the known refuges of northern Australia and Florida. The rarity of sawfish, however, makes traditional fishing surveys largely ineffective, unreliable, and cost-prohibitive, at the scales needed to locate the now low numbers of individual fish. Testing in northern Australia using e-DNA has been shown to effectively identify the presence of sawfish and has provided the opportunity to conduct broad-scale surveys to discover the current distribution of the target species.
* In Western Australia CSIRO are using the Grover technology to capture eDNA to detect marine fish species poorly represented by conventional sampling methods.

Grover Scientific has recently been approached by the University of Queensland who is investigating the use of e-DNA to test for the presence of the corona virus in wastewater flows. This could be an important means of quickly identifying any outbreaks of the disease and helping to target where more corona virus tests should be offered to those living in particular areas. Being able to quickly identify and stop the spread of any outbreaks would have significant public health benefits.

###### Role of the ON program

It is likely that without the team’s participation in the ON program the e-DNA sampling technology they developed would have largely remained a tool for use in the research community. The number of units produced would have been limited, probably no more than around 30.

* 1. 4. Clarifying the Impacts

According to the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES) the gross value of Australian fishery and aquaculture production grew to $3.06 billion in 2016–17.[[3]](#footnote-3) For example, recent and well known example was the outbreak in 2016 of white spot disease. This effectively closed down south-east Queensland’s prawn industry, which produced around 40 per cent of Australia’s farmed prawns and led to major economic losses for Australian prawn farmers.[[4]](#footnote-4)

Protecting aquaculture operations from the impacts of pests or disease clearly has value. However, quantifying any potential benefit that might flow from the use of Grover Scientific’s e-DNA samplers is difficult without additional information about the uptake of the technology and other information to help establish the counterfactual.

Similarly, there would clearly be benefits from an ability to detect an outbreak of a disease such as COVID-19 as early as possible. Rapid intervention in such a case could help reduce the asymptomatic spread of the disease. According to the Office of Best Practice Regulation, a credible estimate of the value of statistical life is $4.9 million and the value of statistical life year is $213,000 in 2019 dollars.[[5]](#footnote-5) Again, it is difficult to reliably estimate the benefit that might flow from the use of Grover Scientific’s product without additional information about the uptake of the technology and what the counterfactual might be. However, we can see that the scale of potential benefits could be considerable even if only one life was saved.

This case study also does not consider the potential for such testing to enable the economy to be restarted earlier than might otherwise have been the case. However, given that the Australian Treasury has estimated that every week the restrictions remained in place led to a reduction in economic activity of close to a $4 billion, the potential benefits from even a small reduction in the time the economy was shut down could be substantial.[[6]](#footnote-6)

Exports of Grover Scientifics’ equipment will provide revenue that benefits the economy. Grover Scientific are expecting to resume sales and clear their current stock of samplers by July 2021. For the purposes of our analysis we have made the more conservative assumption that the COVID-19 pandemic will halt the overseas sales of e-DNA samplers until the end of 2020. We have assumed that when exports begin again that five samplers a month will be exported in the period to July 2021. This will increase to ten samplers a month in the second half of 2021 and increase by 10 samplers a month in each year until 2025 after which sales will plateau. We assume that 20 per cent of the samplers exported are the Grover Go model and the remainder are Grover Pro models.[[7]](#footnote-7)

* + 1. 4.1 Counterfactual

We have assumed that in the absence of the ON program there would. have been no units of the technology produced by the researchers beyond the 30 produced for testing purposes.

* + 1. 4.2 Attribution

In ACIL Allen’s view there would have been no commercialisation of the e-DNA sampling technology in the absence of the research team’s participation in the ON program. We have therefore attributed 100 per cent of the benefits flowing from this project to the ON program.

* 1. 5. Evaluating the Impacts
		1. 5.1 Cost-Benefit Analysis
			1. Benefits

The expected revenues for Grover scientific e-DNA sampler have been estimated using assumption on the number of units sold per annum, and the expected sale price of each unit. The projected revenues of Grover Scientific e-DNA sampler were estimated using the following assumptions:

* Annual sales are 30 units in 2020/21, 120 in 2021/22 which increase at 120 per year until 2025/26 at which 600 are sold from then onward.
* 20 per cent of sales are Grover Go, and 80 per cent are Grover Pro.
* The expected sales price is $1,250 for the Grover Go, and $1,500 for the Grover Pro.

The total revenues of Grover scientific between 2018/19 and 2030/31 with participation in the ON program are shown in **Figure 3**. In the counterfactual (“without ON participation”), revenues are assumed to be zero as it is assumed there was no commercialisation and no product sold.

The incremental revenues (that is, the difference in projected revenues between the two cases) represent a conservative valuation of the benefits generated by Grover scientific, as they do not take into account the “consumer surplus” enjoyed by customers. (That is, some customers would have been willing to pay more than the price charged by Grover scientific, based on the quantum of benefits they expect to gain from purchasing the product/service).

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| **Figure 3** Grover Scientific revenues with participation in the ON program, 2018/19 to 2030/31 (2019/20 dollars) |
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| Note: Revenues without participation in the ON program are assumed to be zero. *Source: ACIL Allen estimates based on information provided* |
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It is assumed that the benefits stream will cease after 2030/31 due to the introduction of similar products in the marketplace by other Australian companies.

* + - 1. Costs

The costs included in the analysis include ON related costs, other upfront cash and in-kind support, and the cost of foreign-sourced inputs which represent a “leakage” out of the Australian economy.

As can be seen in **Table 1** the ON-related costs of the Grover Scientific project were just under $318,480. Other upfront cash and in-kind support totalled $82,000. This results in a total upfront cost of $400,480. The counterfactual is that the product did not reach commercialisation, as such all upfront cash and in-kind support are included as costs in the CBA and there is assumed to be very little or no activity in the counter factual.

The projected total production costs of Grover Scientific e-DNA sampler between 2018/19 and 2030/31 with participation in the ON program are shown in **Figure 1.3**. The costs were provided as $190 per Grover Go and $200 per Grover Pro. Note that the CBA assumes that the costs in the counterfactual (“without ON participation”) are assumed to be zero as it is assumed there was no commercialisation and no product produced and sold.

Note that only the foreign-sourced inputs are included in the CBA as true costs as these represent a “leakage” out of the Australian economy. We have assumed that 20 per cent of production costs are spent on foreign-sourced inputs (See **Figure 4**).

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| **Figure 4** Projected Grover Scientific costs with participation in the ON program, 2018/19 to 2026/27 (2019/20 dollars) |
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| *Source: ACIL Allen estimates based on information provided* |
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#### Net value added

Taking into account this “leakage”, the net value added to the Australian economy by Grover Scientific E-DNA sampler (relative to the counterfactual where the ON program did not exist) is shown in **Figure 5**.

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| **Figure 5** Net value added to Australia by Grover Scientific E-DNA sampler, 2018/19 to 2026/27. (2019/20 dollars) |
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| *Note: Note this excludes the upfront ON costs, and other cash and in-kind support.**Source: ACIL Allen estimates based on information provided* |
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* + - 1. Assessment of benefits against costs

The present value of upfront ON-related costs and other cash and in-kind support incurred by Grover Scientific e-DNA sampler is $413,709 in 2019/20 dollars. The present value of benefits associated with participation in the ON program is estimated at $2.9 million in 2019/20 dollars under a 7 per cent real discount rate.

The net present value (NPV) of participation in the ON program is thus $2.5 million under a 7 per cent real discount rate, while the benefit-cost ratio (BCR) is 7.1. The NPV is calculated by subtracting the present value of costs from the present value of benefits, while the BCR is calculated by dividing the present value of benefits by the present value of costs.

* + - 1. Sensitivity analysis

If the projected revenues of Grover Scientific E-DNA sampler (with participation in the ON program) between 2018/19 and 2030/31 are 20 per cent higher than those in the central case, the BCR will increase from 7.1 to 8.6. Conversely, if the projected revenues between 2018/19 and 2030/31 are 20 per cent lower than those in the central case, the BCR will decrease to 5.7.

If the projected production costs of Grover Scientific E-DNA sampler (with participation in the ON program) between 2018/19 and 2030/31 are 20 per cent higher than those in the central case of the cost-benefit analysis, the BCR will decrease from 7.1 to 7.0. Conversely, if the projected operational costs and cost of goods sold are 20 per cent lower than those in the central case, the BCR will increase to 7.2.

In the central case of the cost-benefit analysis, a 7 per cent real discount rate has been used. The BCR increases to 9.0 under a 4 per cent real discount rate and decreases to 5.7 under a 10 per cent real discount rate.

* + 1. 5.2 Potential future impacts

The use of e-DNA is already a rapidly growing field. The availability of an effective and inexpensive sampling device will be likely to further encourage the use of the technology in a wide range of areas.

###### The ON program’s role

Without the ON program this technology is highly unlikely to have been commercialised.

1. <https://www.smith-root.com/edna/edna-sampler> accessed May 2020. [↑](#footnote-ref-1)
2. Bangladesh, Brazil, Cambodia, Columbia, Costa Rica, India, Kenya, Madagascar, Myanmar, Pakistan, Panama, Singapore, Sri Lanka, Tanzania, Thailand, and Vietnam [↑](#footnote-ref-2)
3. *Australian fisheries and aquaculture statistics 2017*, ABARES, December 2018. [↑](#footnote-ref-3)
4. According to the Australian Prawn Farmer’s Association, the farm gate value of Australian prawn farming in 2014/15 was almost $90 million. <https://apfa.com.au/> accessed May 2020. [↑](#footnote-ref-4)
5. <https://www.pmc.gov.au/sites/default/files/publications/value-of-statistical-life-guidance-note_0_0.pdf> accessed May 2020. [↑](#footnote-ref-5)
6. [https://www.abc.net.au/news/2020-05-04/coronavirus-shutdown-costing-economy-$4-billion-a-week/12213612](https://www.abc.net.au/news/2020-05-04/coronavirus-shutdown-costing-economy-%244-billion-a-week/12213612) accessed May 2020. [↑](#footnote-ref-6)
7. To date users have largely sought to purchase the Grover Pro device. [↑](#footnote-ref-7)