



**AMS**  
American Meteorological Society

## Supplemental Material

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Table S1: Seasonal calendars of the Pacific based on a literature review.

Country	Location (Ethnic group)	Type of calendar (Presented as)	# seasons	# months	Principal Use e.g. Agricultural, fishing, cultural	Reference	Comments
American Samoa		Lunar  (Wall calendar format)	2?	12?	Fishing	Western Pacific Regional Fishery Management Council & NOAA (2012-2019)	Amerika Samoa Lunar Calendar constructed to recognise traditional fishing seasons and culture. May is sacred because of Fe'e (Octopus cyanea) and some coastal villages ban fishing during this time. Aununa is the intermediary month between the rainy and sunny season and occurs sometime between April and June, depending on the year.
Cook Islands	Mangaia, Raratonga (Atiuan)	Lunar  (Descriptive text)	?	12 or 13?	Human activities (spirits, agriculture, fishing)	Clerk (1990)	"... pieces of knowledge connected with the lunar calendar are still used in activities such as planting, fishing, and crab collecting, and the links between specific nights and spirit appearances are sufficiently strong in some minds for the term <i>arapō</i> to be applied to both."
Easter Island	Rapa Nui	Lunar, Stellar  (Table)	4	12	Agriculture, Fishing, Cultural events	Edwards & Belmonte (2004)	Year begins with first crescent of the moon after the rising of Pleiades (Matariki) and the setting of Orion's belt (Tautoru). The first entire lunation of the new year probably included the winter solstice. Movements of stars mark the close of fishing and start of warfare, as well as marking bountiful seasons.
Federated States of Micronesia	Pohnpei Island	Plant  (Graph)	2	?	Agriculture	Raynor et al. (2009)	Yam seasonal calendar, links to feasts and crop activities and productivity. Year is separated into Yam ( <i>rekenpwel</i> ) and breadfruit season ( <i>rekenleng</i> ).
Federated States of Micronesia	Pohnpei Island	Plant  (Descriptive text)			Agriculture	Ragone & Raynor (2009)	One major and four minor breadfruit seasons. Minor seasons show how breadfruit is interconnected with the natural world: land, seas, winds, tides, fish, birds, plants.
Federated States of Micronesia	Chuuk (Moch)	Astronomical / rhythmic structure of natural phenomena  (Key details deleted by author; some	2	12	Agriculture and fish	Pam (2015)	Author requested seasonal calendar be removed from the published thesis. "... on Moch experiences and observations of seasonal conditions resonated with particular activities and practices of everyday life. So whilst the two officially named seasons on Moch were designated months corresponding to specific astronomical conditions and events, various seasonal cycles were not dependent on the month (star) of the year but were 'inherent in the rhythmic structure of specific

		Descriptive text remains)					activities' ". Individual seasons may start earlier or later than usual in a given year.
Federated States of Micronesia	Chuuk	(Figure, cyclic)	5?		Agriculture, Fishing	Kanto (2013)	Students interviewed elders to create seasonal calendars around mango varieties, weather patterns, animals, spawning seasons, etc. Some calendars provided.
Federated States of Micronesia	Caroline Islands, [Yap] {Ngulu}	Astronomy (Descriptive text)	?	12-14 in sidereal calendar [12-13 Yap] {12-13 Ngulu}	Navigation, Social activities	Goodenough (1951)	30-day lunar month. For periods longer than a month a sidereal calendar was used. Ngulu divide the year into 12 months, a 13 <sup>th</sup> added in leap years, to bring the lunar and sidereal calendars back into phase. Navigators use stars to determine the best time of year for voyages. Stars used to time preparation, what the prevailing winds and currents will be when they embark, and how long they can safely be away. A feast-day calendar is based on seasonal variations in the breadfruit crop.
Fiji	Viti Levu (Verata)	(Table)		12	Agriculture, Fishing	Nainoca (2011)	Fijian months named according to tasks or phenomenon. Only Fijian names are given, not local names for Verata.
Fiji		Lunar (Table)		11	Planting, Fishing	<a href="http://www.fijianculture.com/p/vula-vakaviti-fijian-calendar.html">http://www.fijianculture.com/p/vula-vakaviti-fijian-calendar.html</a>	Fijian calendar is based on planting and fishing seasons. Year begins in June/July. Vula means moon and is also the Fijian word for month. First 3 months are concerned with preparing for planting. Next 4 months are named after fish.
Fiji	Kabara	(Table; Figure, cyclic)	2-3?		Agriculture, Fishing	WWF (2009)	"A seasonal calendar is a tool for documenting regular cyclical periods (i.e. seasonal) and significant events that occur during a year and influence the life of a community. It provides a general picture of important environmental, cultural and socio-economic periods throughout the year. The seasonal calendar is of value as it allows local people to represent their understanding of seasons from their culture. These are often different from 'official' seasons and the International calendar." Seasonal calendar used to discuss climate change impacts and to identify changes seen.
Guam	(Tumon)	(Figure, cyclic)	2?	?	Agriculture, Fishing	The Nature Conservancy (2014)	Calendars presented in pictorial form but hard to read and not really discussed. No local names provided for seasons or months. "main weather event that was significant enough that people use it to tell time, was the typhoon" – more a marker of years than seasons.

Guam	(Chamorro)	Lunar  (Wall calendar format)		12-13?	Agriculture, Fishing	Western Pacific Regional Fishery Management Council & NOAA (2012-2019)	Lunar calendar shows monthly availability of key harvest species (e.g. calendar for 2018).
Marshall Islands		(Figure, cyclic)	2	12?	Agroforestry	Pacific Islands Climate Science Center (PI-CSC) (2017)	Compares agroforestry (harvest times of traditional crops only) in normal and El Niño years. Interactive version at <a href="http://oos.soest.hawaii.edu/pacific-rcc/Marshalls_Agroforestry/site/">http://oos.soest.hawaii.edu/pacific-rcc/Marshalls_Agroforestry/site/</a> . El Niño year makes Rak (early and wet). Each atoll could have its own calendar – northern atolls have a strong dry season and are more effected by El Niño droughts.
Marshall Islands		(Descriptive text)	2		Agriculture	Rudiak-Gould (2012)	Seasons used to predict harvests, rainfall and ocean conditions. Have seen changed seasons and new species.
New Zealand	(Māori)	Lunar  (Table)	4	12 (some tribes had 13 <sup>th</sup> intercalary month when required)	Horticulture, fishing, hunting	Orchiston & Orchiston (2017)	Ancestral calendar system from Society Islands, evolved to adapt to new landscape of NZ. East coast of North Island – New Year marked by the appearance of first new moon after rising of Pleiades (late May to early June). Far north of South Island and Chatham Islands – New Year marked by rising of Rigel (one of brightest stars in Orion). Different tribal areas had their own names for the months, some named according to specific events. Close association between calendar and food-quest activities. Signs from plants and animals indicate timing of planting but astronomy more important when harvesting kumara crop. Festivals follow the harvest. “As an integral part of culture, astronomical systems also evolve”.
New Zealand	Bay of Plenty (Māori: Te Whānau-ā-Apanui)	(Table)	6			King et al. (2008)	"... Te Whānau-ā-Apanui's locally developed seasonal framework which is based on six seasons. Not only do other iwi share this framework across New Zealand but it is also like the six seasons described by indigenous peoples in different parts of Australia".
New Zealand	(Māori)	Lunar  (Descriptive text)	4	12-13	Food procurement, social activities, rituals	Roberts et al. (2006)	Similarities and differences between tribal/geographical areas. Northern tribes are horticulture dominant, sea fishing for coastal tribes and for inland people forest foods and freshwater fish. Number of moon nights in each month varied from 29-32. Stars and flowering of plants used, with phases of moon, to indicate seasons of the year. Some

							authors say they added some moon nights to the year to maintain seasonal synchronicity, some that a 13 <sup>th</sup> month was used every few years – the report found no evidence of any location using 12 months in one year and 13 in another, suggesting number of months in a year may vary by location but is fixed from year to year.
Palau	Babelthuap Island (Ngermetengel)	Lunar  (Table; Figures, including cyclic)	2	12 + 1 transition period	Fishing	Klee (1976)	Two main seasons: Rekil Ongos – of the easterly wind (Nov-Apr) and Reki Ngebard – of the westerly wind (May-Oct). Months begin when rim or crescent of new moon first appears in the west. Plants either have no seasonality, one or two fruiting seasons. The Ngermetengel clock and calendar is “used to describe the landscape as well as to predict the probable whereabouts and activities of its people for a given period of time”. Fishing is the most cyclic of activities for this village – cultivation of taro and cassava varies little with the seasons. Only a few old traditional fishermen observe and use nature’s cycles and only a few old people remember and use parts of the calendar. “Further deterioration of Ngermetengel’s clock and calendar (the awareness of nature’s dynamic cyclic rhythms and interrelationships) will lead to further deterioration of the environment”.
Palau		Lunar  (Table)	2	12 + 1 transition period	Resource exploitation	Takeda & Mad (1996)	6 lunar cycles with wind from the east and 6 when wind blows from the west. First month of year begins with appearance of new moon at the horizon. Months are 30 days long.
PNG	Takū, Mortlock Islands	Astronomy  (Descriptive text)	?	?		Moyle (2003)	Located 200 km off PNG but the people are of Polynesian origin. Weather patterns are linked to seasonal characteristics of specific constellations. "Star indicators of the start of each season are provided by Tauhä which, when visible in the western sky in the early morning, signals the period of northwest trade winds (Te Laki) and when visible at dawn in the eastern sky announces the start of the southeast winds (Te Anäke)"
PNG	Tobriand Islands (Yami, Vakuta, Kitava, Kuboma, Kiriwina, Wogeo)	Lunar  (Table)	?	12-13	Farming, Fishing, Rituals	Leech (1950)	Seasonal cycle starts on a full moon and is directly influenced by the solar year (though this is "not appreciated by the Tobrianders"). Names for 10 months are well known, the others less so and are perhaps redundant. The Milamala 'month' may cover four lunar months, thus removing the

							need to name more than 10 months. Appearance of the palolo worm helps set the timing of the months. The timing of this 'month' can vary from place to place. Intercalation may be used by the various groups. The Yami calendar is predominantly fishing related.
PNG	Tobriand Islands	Lunar (Table)	2 unequal lengths	10-12	Natural events and human actions	Malinowski (1927)	In Melanesia the main division of seasons is established by the two prevailing winds. Trade winds from the south-easterly direction blow during the winter months (May to November). Division of the seasons is associated with growth of vegetation, which starts its new lease with the beginning of the wet season. The trade winds mark the dry season, in which many fruits and plants ripen, while in bad years there are droughts and stagnation.
PNG	(Maenge)	Solar, Lunar (Descriptive text)	2 (dry and wet)	12	Natural events and human actions (plants, animals etc.)	Panoff (1969)	On each succeeding morning the direction of the sun at rising shifts from east-southeast to northeast between January 1 and June 22, and back from northeast to east-southeast between July 1 and December 22. In Maenge country this alternating shift describes an arc of about 50 degrees on the compass. The Maenge are aware of the phenomenon and use it as an index of time-reckoning in addition to their lunar calendar.
PNG	Upper Lai and Ambrum valleys, Wabag district, Western highlands (Maenge)	Luni-solar (Table)	2 (wet and dry)	12-13	Agriculture, Fishing	Meggitt (1958)	Men are more likely to know the calendar than women. Month names not always consistent from clan to clan. Use of intercalary month.
PNG	Manus Island (Titan speaking Manus)	Lunar / Astronomy (Descriptive text)	2 (wet and dry)	12	Fishing, Agriculture	Hoeppe (2000)	"While only a small number of constellations had been named, these were sufficient to function as a calendar, a visualization of the seasonal cycle and a metaphorical explanation of the seasons. " "to the Manus, the night sky did not only serve as a 'calendar,' but was also seen as a representation of the seasons which was suited to make sense of the changes as they were observed in the environment." The lunar and sidereal calendars were used in different contexts and it was not seen as important if they did not align precisely.
PNG	Fly River Delta (Kiwai)	Lunar (Descriptive text)	2	13	Natural events and human actions	Riley & Ray (1924)	The natives on the coast at Parama, Katatai, Tureture and Mawata have only 12 moons per year.

							The year is divided into two seasons the rainy (north-west; <i>Suruma</i> ), made up of 5 moon cycles, and dry and windy season (south-east; <i>Uro</i> ), made up of 8 moon cycles.
PNG	Southern Highlands Province (Wola people)	Solar (Descriptive text)	2 equal length seasons	12		Sillitoe (1994)	The difference between seasons are not marked and the weather data supports this, rather the division is related to the sun's path. Phenology also marks differences between the seasons.
PNG	Southern Highlands Province, Was Valley (Wola people)	Lunar (Descriptive text)	2	12 (today)		Sillitoe (2006)	Lunar cycle marks the passage of a month. Seasons are April to September (cool) and October to March (warm). Each season has 4 to 6 months – some disagreement on how many.
PNG	Trobriand Islands (Kiriwina, Vakuta)	Lunar, astronomy (Descriptive text; Table)	?	12-13	Gardening	Austen (1939)	New year for Trobriand marked by morning or evening rise of Pleiades. The new year for Vakuta coincides with rise of palolo annelid. Intercalation using a thirteenth garden period.
PNG	Trobriand Islands, Woodlark Island (Trobriand, Muyuw)	Lunar (Table)	2 (Muyuw)	12 (Muyuw)	Gardening	Damon (1982)	Discussion of previous calendars constructed for the Trobriands (Malinowski 1927, 1967) and Austen (1939). Differing number of months and timing. Eastern Muyuw have two seasons with 'dividers' between them (Feb/Mar and September). Variations seen in calendars and customs from Eastern to Central to Western parts of island. Proposes Trobriand and Muyuw calendars have the same social origin.
PNG	Woodlark Island (Muyuw)	Lunar (Table)	2	12 (East) 13 (Central)		Damon (1996)	Two main seasons and two transition periods. Winds and tides define transitions. Months/parts of year closely linked to biological events, e.g. appearance of flowers of Flower Tree. Comparison provided with Trobriand Island (Vanuta, northern TI, central TI, central Kitava) and Eastern and 'other' Muyuw.
PNG (& Indonesia)	Maenga, Western Highlands, Fly River, north coast (Maenga, Mae Enga, Kiwai, Wogeo)	Maenga: Plant phases Mae Enga: Lunar/solar Kiwai: lunar/astrological Wogeo: astrological, palolo worms		12 (Maenga) 13 (Mae Enga) 13 (Kiwai) 6 (Wogeo)		Yoshida (1980)	Classifies calendars by type: sidereal, natural phenomena, luni-natural phenomena, luni-solar, luni-sidereal and lunar. Maenga: 9 months of 30 days; one of 15 days and 2 of 5 weeks. Names of months related to plant phenology. Kiwai: 8 of the months named after stars or constellations. Wogeo: calendar used for fixing dates of celebrations and ceremonies, not agriculture. Comparison of various calendars in PNG, Indonesia, NZ, Samoa and Tonga.

		(Descriptive text)					Calendars of PNG "so varied that there are no salient characteristics".
Polynesia	-	Lunar  (Table)	?	12	Horticulture	Connaughton (2012)	Ancestral Polynesian lunar calendar linked with main phases of yam crop. Month names reflect natural events that signify when yam planting and harvest occurred. Proto Polynesian horticultural calendar has 12 months. Palolo months mark ecological transition from dry to wet seasons. "Yam calendar in western Polynesia becomes a taro and breadfruit calendar in eastern Polynesia, revealing a change in subsistence".
Samoa		(Descriptive text)	2	12	Agriculture, Fishing	Anon. (1928)	Tahitians had two seasons: Pleiades above and Pleiades below. Samoa year began with the coming of palolo. Two seasons: wet and dry. Compares month names from previous works in Samoa (Turner 1884 and Pratt-Fraser 1891) – both had 12 months. January to March concerned with yam digging and withering. Lists of alternative names – not always the same.
Samoa		Lunar  (Descriptive text)	2	12		Turner (1884)	"Moon is the timekeeper of the year". Name for each month was common over the group, with some local exceptions. "Intercalation was each, and the names of the twelve moons kept uniform". July is the first month of the half year (Palolo season), the other half called the trade-wind season.
Samoa		Environmental changes  (Descriptive text)		19?		Lefale (2003)	Lists Samoan seasonal descriptions against equivalent Gregorian months. Unclear if descriptions are Samoan months or just significant events at that time of year.
Samoa		Environmental changes  (Table)	2	17?		Lefale (2010)	"... the Samoan calendar is based on the onset of extreme weather and climate events and other environmental indicators, particularly the palolo". The names of the months can vary by island and village. Lists Samoan seasonal descriptions against equivalent Gregorian months. Unclear if these descriptions are Samoan months or just significant events at that time of year.
Solomon Islands	Simbo, Eddystone Island (Simbo)	Plant, wind  (Figure, Table)	2	10	Gardening, fishing, other activities	Burman (1981)	Seasons named after 2 species of canarium nut and have particular wind directions. Winds and maturity of nuts give names to months. Formal calendar predominantly concerned with men's activities – seasonal women's

							activities, such as shellfish collecting, not included. Two transition periods. Nuts no longer seen as important seasonal markers.
Solomon Islands	Pileni Island (Pileni)	?	?	?	?	McNaught et al. (2011)	Locals observed changes in their environment – weather, health and crops – documented using amended Red Cross seasonal calendar tool. Modern seasonal calendar presented in Gregorian fashion. Not clear how many traditional seasons or months or what they were called.
Solomon Islands	Koqu, Western Province (Koqu)	?	2	?	Agriculture	IFRCRCS (2005)	Two main seasons, with transition period between the wet (Peza) and dry (Bule) seasons (called Ragi). Crop calendar provided but no details on how it was constructed.
Solomon Islands		?	2	?	?	Keremama et al. (2019)	Two seasons, warm wet (November to April) and cool dry (May to October). Local names for seasons, Komburu and Ara, are based on prevailing directions of the trade winds.
Tokelau Islands (NZ)		(Text)		12		Anon. (1928)	Non-self-governing territory of NZ, 500 km north of Samoa. Provides only the names for the months. Some similarities to Samoan month names.
Tonga		Plant, animal, lunar  (Descriptive text)	2	12-13	Agriculture	Collocott (1922)	Division of calendar based on plant and animal behaviour, primarily yam phases. Normal years have 12 months, some years have 13. In the 12 <sup>th</sup> month, if "observations of the yam and other plants and of fishes at the next new moon fails to discover the appearance proper to the month with which the year begins, Lihamua, another month is intercalated". Year may start when the Pleiades appear on the eastern horizon just after sunset. Nomenclature is largely agricultural, but names likely also applied to the moons. Division of the month was based on moon phases.
Tonga	'Ancient'	Lunar  (Descriptive text)	2	13	Agriculture, fishing, culture	Kanongataa (2011)	Each lunar month consisted of 28 days. "Within each month the moon is considered to go through three different phases ... The month began with a thin crescent of the new moon and was first visible at sunset. It took 12 days from the point of moonrise to the point of displaying a full moon, and another 12 days to moon set. The moon disappeared for a period of 4-5 days before rising again." Crops said to grow best if planted between period of moonrise and full moon; weeding is best performed when the moon starts to phase out. The period of the 4 to 5 days between the setting of the moon and its rise normally known as "the disappearing of the moon" is considered the

							best time for land or seed bed preparation and preparation of planting materials. Smallholder farmers normally set out their farm work programme accordingly, "we never plant our root crops beyond the full moon phase or when the moon is weak, we will receive low yields, and we never weed before the full moon phase when the moon is strong, as it is hard to kill weeds during this time". It is evident that some rural farmers know the basic calendar and still operate accordingly to some extent."
Tonga		Lunar, astronomy  (Figure, cyclic)		12	Agriculture	Taulaufale (2015)	Calendar based on astronomy and ancient Tongan political culture. Mentions commonly accepted ancient Polynesian calendar of 13 months and discusses how this is not correct and provides a "correct" ancient calendar of 12 months.
Tuvalu	Funafuti	?	?	?	?	Alefaio (2008)	Mentions they developed calendars; no further details provided. "climate change weather pattern is causing agricultural plants not to follow the seasonal calendar"
United States of America	Hawai'i, North Kona District, Hawai'i Island (Ka'ūpūlehu)	Lunar  (Descriptive text; Figure, cyclic on web)	2 (web calendar)	12-13 (web calendar)	Fishing, Agriculture, Travel	McMillen et al. (2017)	Cocreated a seasonal calendar based on TK that integrates other knowledge. It included TK related to forecasting ("cycles with wind, rains, currents, astronomy, and phenological cycles of plants and animals that guided the timing of fishing, planting, harvesting, ocean travel, and relocation in the past"). Link to seasonal calendar in paper is broken but can be found at <a href="http://nakiloaina.com/calendar/">http://nakiloaina.com/calendar/</a> . Knowledge of cycles of weather and astronomy (seasonal calendar) used regularly until 1840. During this time the moon calendars indicated sanctioned timing of harvest. After this time, it was used less for resilience and by 1960 use was "greatly reduced, moon calendars still used by some." New seasonal calendar created (link above) in 2010's. "Proverbs encode information on the timing of seasonal plant and animal cycles". Traditional methods are being adapted to meet current conditions, e.g. "native tree populations have decreased, today people look to widely distributed introduced species to signal the appropriate times to harvest sea urchins". TK associated with weather and phenological cycles has application to climate change adaptation. <i>Melemele</i> is an 'optional' season around November.

United States of America	Hawai'i	Lunar (Descriptive text)	2	12		<a href="http://what-when-how.com/ancient-astronomy/hawaiiian-calendar">http://what-when-how.com/ancient-astronomy/hawaiiian-calendar</a>	Significant differences from one island to another. Hawaiian year is called <i>makahiki</i> . Most month names used on more than one island and followed similar sequence but timing within the year varied. Two seasons of six months. No record of intercalary month. Beginning of winter – appearance of Pleiades in eastern sky just after sunset. Summer (~ May) – first appearance of Pleiades in eastern sky before dawn. Each month has 30 nights.
United States of America	Hawai'i (Mauka-Makai Kalaemanō)	(Figure, cyclic)	2	12-13	Agriculture, Fishing	<a href="http://hbmpweb.pbc.hawaii.edu/kau-pulehu/seasonal%20calendar">http://hbmpweb.pbc.hawaii.edu/kau-pulehu/seasonal%20calendar</a>	No details given on how the calendar is constructed. Links to <a href="http://nakiloaina.com/calendar/">http://nakiloaina.com/calendar/</a>
Vanuatu	Tanna	Natural occurrences  (Table)	2	14	Farming	Mael (2013)	The calendar is centred on the yam [Table 28 in Mael 2013]. Month of May is divided into two and is considered the most important time of the year, as it is the harvest season. It is unclear from this report what the 14 <sup>th</sup> month is. Traditional planting calendars for several locations in Vanuatu are also provided.
Vanuatu	Torres Islands	Lunar  (Table)		11	Agriculture	Mondragon (2006)	Although listed as lunar months, they are not "precise lunations or lunar cycles", dependent on "a chain of (ecological-driven) events". The "calendrical framework of the Torres essentially constitutes an informal device for ordering cycles of food-production and social reproduction". Social reproduction includes ritual and ceremonial exchange events. A seasonal and horticultural calendar is provided.
Vanuatu	Torres Islands (Loh and Toga)	Lunar, Winds, Clouds  (Table)	2	11-12	Agriculture	Mondragon (2004)	Winds, sun and moon form the basic temporal markers of the calendar by inducing changes in biorhythms of plants and animals. Palolo is a seasonal indicator of time and important for rituals. Seasons are defined by "prevailing winds and by the periodic movement of the sun to the south and north of the thermal equator." Horticultural cycle divided by two 'wind' seasons. Lunar year is a basic temporal marker. "The people of these islands register the seasonal fluctuations that characterise their world by means of a lunar 'calendar' whose primary function is to correlate important environmental and celestial movements with the various phases of the horticultural cycle ... In combination,

							the regular displacement of the winds and the annual motions of the sun and moon — the basic temporal markers of the Torres ‘calendar’ — induce changes in the biorhythms of local plants and animals. In turn, Torres people relate to the heavens, the weather and the biorhythms of their world by variously attributing particular forms of <i>mena</i> to each of these phenomena." Mena or <i>Mana</i> is intimately “linked to organic generativity and thus to all forces of growth and vitality”
Vanuatu	Penama, Sanma, Malampa	(Table)	6 (Sanma) 3 (Malampa)	13 (Penama)	Agriculture	VMGD (2012)	Workshop report from this project. Provincial traditional calendars were drafted, primarily as crop calendars. Some draft calendars lacked details of the traditional length and names for the seasons and months. For Penama, traditional month length is 28 days, likely lunar months, with an extra month of 29 days. Lists changes seen in weather, cropping and animals over time.
Vanuatu	Tafea, Malampa,	(Table)	2	?	Agriculture	VMGD (2013a)	Workshop report from this project. Built on calendars produced during VMGD (2012). No traditional names for seasons or months. Natural indicators provided for the seasons.
Vanuatu	Penama, Sanma	(Table)	4 (Penama) 6 (Sanma)	12 (Penama)		VMGD (2013b)	Workshop report from this project. Although activity calendars are provided for 5 provinces, only a few had traditional seasonal names and timing.
Wallis and Futuna	Futuna	Lunar  (Table)	2	12-14	Agriculture, rituals	Kirch (1994)	Futuna ritual cycle integrated into seasonality of agriculture, especially first harvest of yam and breadfruit. Seasons are <i>palolo-mua</i> and <i>polo-muli</i> , though no palolo occur in Futuna. 14 months in Figure 3 with 12 or 14 listed by other authors in the agricultural calendar of Table 1.
Wallis and Futuna	Uvea (Uvea people, Western Polynesian)	Astronomy, Ecological cycles?  (Descriptive text; Graph)	2 (Wet and Dry)	13	Agriculture, rituals	Kirch (1978)	Modern Uveans utilise the church introduced Gregorian calendar to organise time. Old agricultural calendar likely based on astronomy and ecological cycles and matches very closely to that of Tonga. The Uvean agricultural calendar is centred around cultivated yam species. Catholicism obliterated traditional religious activities.

## References

- Alefaio S (2008) Training of Trainers Workshop on Vulnerability and Adaptation (V&A) on Climate Change in Tuvalu Workshop Report, 8th – 11th July 2008, Funafuti, Tuvalu. In: *Climate Change and Variability Implications on Biodiversity – Youth Scenario Simulations and Adaptations*. Final Report submitted to APN. <https://www.apn-gcr.org/resources/files/original/4c99c2c17dacdda2d1e9a4f38b993a53.pdf>
- Anon. (1928) The Samoan division of time. *Journal of the Polynesian Society*, 37, 228-240.
- Austen L (1939) The seasonal gardening calendar of Kiriwina, Trobriand Islands. *Oceania*, 9, 237-253.
- Burman R (1981) Time and socioeconomic change on Simbo, Solomon Islands. *Man*, 16, 251-267.
- Clerk C (1990) "That Isn't Really a Pig": Spirit traditions in the southern Cook Islands. *Oral Tradition*, 5, 316-333.
- Collocott EEV (1922) Tongan astronomy and calendar. *Occasional Papers of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History*, 8, 157-173.
- Connaughton SP (2012) A story of yams, worms, and change from ancestral Polynesia. *Journal of Island and Coastal Archaeology*, 7, 161-167.
- Damon FH (1982) Calendars and calendrical rites on the northern side of the Kula Ring. *Oceania*, 52, 221-239.
- Damon F.H. (1996) The Woodlark Island calendar: Contexts for interpretation. *Archeoastronomy*, 12, 349-357.
- Diettrich B (2018) "Summoning Breadfruit" and "Opening Seas": Toward a performative ecology in Oceania. *Ethnomusicology*, 62, 1-27.
- Edwards ER, Belmonte JA (2004) Megalithic astronomy of Easter Island: A reassessment. *JHA*, xxxv, 421-433.
- Goodenough WH (1951) Native astronomy in Micronesia: A rudimentary science. *The Scientific Monthly*, 73, 105-110.
- Hoeppe G (2000) When the Shark Bites the Stingray. *Anthropos* 95:23-26.
- IFRCRCS (2005) *Solomon Islands: From risk assessments to community actions*. International Federation of Red Cross and Red Crescent Societies.
- Kanongataa S (2011) Tonga Traditional Farming Systems. *ICH Courier* 8: 16 pp.
- Kanto KK (2013) *Traditional seasonal calendars: Seasonal calendars for resource management*. 2013 Indigenous Fellow Institute: Connecting Tribal and Pacific Rim Colleges to Improve Indigenous Environmental Technology Education Programs.
- Keremama M, Holland E, Khan MGM, Hiriasia D, Tahani L (2019) Air temperature trends, variability and extremes across the Solomon Islands: 1951-2011. *Pacific Dynamics*, 3, 15-32.
- King DNT, Skipper A, Tawhai WB (2008) Māori environmental knowledge of local weather and climate change in Aotearoa – New Zealand. *Climatic Change*, 90, 385-409.
- Kirch PV (1978) Indigenous agriculture on Uvea (Western Polynesia). *Economic Botany*, 32, 157-181.
- Kirch PV (1994) The pre-Christian ritual cycle of Futuna, Western Polynesia. *Journal of the Polynesian Society*, 103, 255-298.
- Klee GA (1976) Traditional time reckoning and resource utilization. *Micronesia*, 12, 211-246.
- Leech ER (1950) Primitive calendars. *Oceania*, 20, 245-262.
- Lefale PF (2003) Seasons in Samoa. *Water & Atmosphere*, 11, 10-11.
- Lefale PF (2010) Ua 'afa le Aso Stormy weather today: traditional ecological knowledge of weather and climate. The Samoa experience. *Climatic change*, 100, 317-335.

- Mael HS (2013) *Climate change and agriculture in Vanuatu: A study of crops and farming system*. FAO. <https://reliefweb.int/sites/reliefweb.int/files/resources/CC%20and%20Agriculture%20in%20Vanuatu.pdf> (accessed 30 August 2019)
- Malinowski B (1927) Lunar and seasonal calendar in the Trobriands. *The Journal of the Royal Anthropological Institute of Great Britain and Ireland*, 57, 203-215.
- McMillen H, Ticktin T, Springer HK (2017) The Future Is Behind Us: Traditional Ecological Knowledge and Resilience over Time on Hawai'i Island. *Regional Environmental Change*, 17, 579–592.
- McNaught R., Vudi Ngatulu C., Tego G., Lewis-Nicholson T. (2011) *The adaptive capacity of Pileni Island community, Viakau Ward, Temotu Province, Solomon Islands*. Department of Climate Change and Energy Efficiency, Australia. April 2011. <http://www.environment.gov.au/climate-change/adaptation/publications/adaptive-capacity-pileni-island-community-viakau-ward-temotu-province-solomon-islands> (accessed 2 January 2019)
- Meggitt MJ (1958) Mae Enga time-reckoning and calendar, New Guinea. *Man*, 58, 74-77.
- Mondragon C (2004) Of winds, worms and Mana: the traditional calendar of the Torres Islands, Vanuatu. *Oceania*, 74, 289-308.
- Mondragon C (2006) Time and the expression of temporality in the Torres Islands, Vanuatu. *Revista Etnologic de Catalunya* DRAFT
- Moyle R (2003) Waning stars – changes to Takū's star knowledge. *The Journal of the Polynesian Society*, 112, 7-31.
- Nainoca WU (2011) *The influence of the Fijian way of life (bula vakavanua) on community-based marine conservation (CBMC) in Fiji, with a focus on social capital and traditional ecological knowledge (TEK)*. PhD Thesis, Massey University, New Zealand.
- The Nature Conservancy (2014) *Adapting to a changing climate workshop report*. Tumon, Guam, March 10-14, 2014.
- Orchiston W, Orchiston DL (2017) The Māori calendar of New Zealand: a chronological perspective. In Nha I-S, Orchiston W, Stephenson FR (eds) *The history of world calendars and calendar-making*. Proceedings of the International Conference in Commemoration of the 600<sup>th</sup> Anniversary of the Birth of Kim Dam. Seoul, Yonsei University Press, pp 57-78.
- Pacific Islands Climate Science Center (PI-CSC) (2017) *Pacific Islands Climate Science Center 5-year Summary Report 2012-2017*.
- Pam CR (2015) Coral, Culture and climate change: 'the facts that matter' for the atoll island community of Moch, Chuuk, Federated States of Micronesia. PhD Thesis.
- Panoff M (1969) The notion of time among the Maenge people of New Britain. *Ethnology*, 8, 153-166.
- Ragone D, Raynor B (2009) Breadfruit and its traditional cultivation and use on Pohnpei. Pp 63-88 in Balick MJ (ed) *Ethnobotany of Pohnpei*. University of Hawai'i Press, Honolulu.
- Raynor B, Lorens A, Phillip J (2009) Yams and their traditional cultivation on Pohnpei. Pp 40-62 in Balick MJ (ed) *Ethnobotany of Pohnpei*. University of Hawai'i Press, Honolulu.
- Riley EB, Ray SH (1924) Kiwai seasons. *Man*, 24, 73-75.
- Roberts M, Weko F, Clarke L (2006) *Maramataka: the Maori Moon Calendar*. Research Report No. 283, Agribusiness and Economics Research Unit, Lincoln University.
- Rudiak-Gould P (2012) Promiscuous corroboration and climate change translation: A case study from the Marshall Islands. *Global Environmental Change*, 22, 46-54.
- Sillitoe P (1994) Whether rain or shine: weather regimes from a New Guinea perspective. *Oceania*, 64, 246-270.
- Sillitoe P (2006) What labour engenders: women and men, time and work in the New Guinea highlands. *Asia Pacific Journal of Anthropology*, 7, 119-151.
- Takeda J, Mad PK (1996) *Traditional Palauan lunar calendar and the fishing-gleaning activities on reef flats and/or in lagoons in the Western Caroline Islands, Micronesia*. Kagoshima University Research Center of the South Pacific, Occasional Papers No 30, 91-106. Survey Team II, Report 7. The Progress Report of the 1995 Survey of the Research Project "Man and the Environment in Micronesia".
- Taulaufale (2015) *Ancient Polynesian calendar* <http://thfale.com/ancient-polynesian-calendar/>

Turner G (1884) *Samoa: A hundred years ago and long before*. London Missionary Society, Inst. of Pacific Studies, USP, Suva, Fiji

VMGD (2012) *National summit to improve understanding on climate, climate change and its impacts on agriculture and land-based sectors*. 12-16 March 2012, Luganville, Vanuatu. <http://www.nab.vu/national-summit-improve-understanding-climate-climate-change-and-its-impacts-agriculture-and-land> (accessed 19 March 2018).

VMGD (2013a) *National workshop on traditional knowledge of weather and climate*. Lounamua Village, Pele Island, Efate, 15-19 April 2013. Vanuatu Meteorology and Geohazards Department, SPC-GIZ, Vanuatu Cultural Center and Vanuatu Red Cross.

VMGD (2013b) *National conference to disseminate adaptation technology and practice in climate services and agricultural resilience*. Theme: Building community resilience through weather and climate information. Tanna Island, Vanuatu, 20-24 May 2013. Vanuatu Meteorology and Geohazards Department and SPC-GIZ.

Western Pacific Regional Fishery Management Council & NOAA (2012-2019) <http://www.wpcouncil.org/education-and-outreach/lunar-calendars-2/>

WWF (2009) *Climate Witness: Community Toolkit*. South Pacific Programme Regional Office. <http://wwf.panda.org/?162722/Climate-Witness-Community-Toolkit>

Yoshida S (1980) Time reckoning. *Senri Ethnological Studies*, 7, 89-107.