Predictably, a vast collection of genes involved in flavour formation in fruits has been discovered[8]. New combinations of genes may lead to the development of new flavours. However, flavour formation in grapes is known to be directly linked to its growing conditions and environment. Use of available genes to yield better pest resistance might be an easier attainable goal. Diseases, such as anthracnose, mildew and PD have handicapped the industry for decades. Discovering the gene/s or gene products involved in grape disease resistance could help breeding programmes all over the world achieve their goals in a shorter period of time. The genome sequencing of Pinot Noir should put the grape community a bit closer to achieving this goal.

Global warming has accelerated faster than anticipated. This has forced sugar levels, and consequently alcohol levels to become higher in the wines. Some producers are adding acidic compounds to their wines to prevent them from becoming too sweet and undrinkable. Growers in Spain, Italy and southern France are buying land at higher terrains for future vineyards. Southern England will probably benefit from planet warming. The British wine industry is re-emerging for the first time in the 500 years since a minor ice age cooled Europe.

Finally, here are some possible remedies. As shown in the genome sequencing of Pinot Noir, research is under way to address some of the ills facing the grape industry. In view of the recent alarms on global climate change, the southern states might be called in to play a major role in the future of the grape industry. Eventually, they will house the shift to new geographical cultivation. And this can only be achieved through intensive research and development efforts toward germplasm acquisition and distribution. In addition, to correct deficiencies, new tools have to be developed to evaluate local, regional and national needs. The above needs can only be achieved by encouraging and developing interactions between breeders and grape enthusiasts all over the world.

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Should endemic and threatened freshwater ornamental fishes of Kerala part of the Western Ghats biodiversity hotspot be captive bred for international trade?

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The highly endemic stream fishes of the Kerala part of the Western Ghats (WG) are now an important component of the global ornamental fish trade. Currently, 114 ornamental species from the Kerala part of the WG are being exported[1], having increased from just ten species at the beginning of the decade[2]. These native ornamentals are in great demand in international markets, and some species like, *Puntius denisonii* command exorbitant prices[3]. Our analysis based on regional conservation assessment[4] revealed that out of 114 exported species, 11 are critically endangered (CR) and 24 are endangered (EN). Further, 44 fish species in the export list[1] are strictly endemic to the WG eco-region and not found anywhere else in the world. Even though there are only 13 full-time active exporters of ornamental fishes from India[5], the stock sizes of many native ornamentals of the WG have declined significantly due to indiscriminate exploitation[2]. Some CR species found in the trade (*Osteochilus longidorsalis*, *Pterocryptis wyanaadensis* and *Horaglanis krishnaii*) have shown a population decline of 99% in the last two decades[2].

The fishery for ornamentals in the streams of Kerala is an open-access one, devoid of any quotas or access restrictions[6]. No regulation on either catch or effort is in place, nor is there any policy directed towards native ornamental fisheries. Lack of regulations is in part because native ornamentals are thought to be a free commodity which can be collected from nature. In the absence of any realistic initiatives in fisheries management and/or conservation, captive breeding is widely considered to be the only panacea for sustainable ornamental fish trade by acting as a supply-side policy for relieving pressure on wild collection.

The Species Survival Commission (SSC) of the IUCN[7] has astutely pointed out that 'captive breeding programs involving species at risk should be conducted primarily for the benefit of the species and that, acquisition of animals for such programs "should not" encourage commercial ventures or trade'. However, this is in total contrast to the current state of affairs in the WG region, where captive breeding is seen as an important economic instrument to generate foreign exchange. Un-

fortunately, captive propagation often leads to increased pressure on wild populations through increased harvest pressure on the wild stocks to supply captive breeding ventures, along with covering for supply deficits[8]. The Government of Kerala is actively promoting trade in native ornamentals and is urging locals to do more to cash in on the current boom in tropical fish exports[9]. Such an attitude from the Government is highly discouraging and is sure to have a negative impact on the biodiversity of the region. A classical example of such an unplanned development which has now resulted in a sustainability crisis is India's marine fisheries sector. It is now known that India's marine fisheries have suffered sequential depletions and are unsustainable at the ecosystem level[10], due to irresponsible fishing practices and the absence of any management during development phases. The ongoing thrust to generate excessive revenue has led to this existing overcapacity and dwindling stocks. This scenario can repeat itself in the inland waters of the country, especially so in the case of unmanaged and open-access native ornamental fisheries of the WG. Thus, it is highly imperative that the native ornamental fisheries of the WG are managed immediately, and subsequently promoted as an example of ecologically integrated harvest that is working towards sustainability, with a focus on ecological preservation with economic development[11] and not adopting the strategy of 'making hay while the sun shines', by haphazardly promoting a sunrise industry.

Commercialization of captive breeding technologies of fish (especially during infant stage) carries several risks that remain poorly documented and realized. Discussing some of these risks, we argue that popularization of such 'know-how' for endemic and threatened ornamentals of the Kerala part of the WG will lead to an even more complex conservation crisis and ultimately a sad paradox that 'captive breeding may be a bigger contributor to further endangerment and possible extinction' of many species.

When a species is 'discovered' by the aquarium trade, the sudden interest associated with it may often lead to a decline in its wild populations[8]. Such a case of 'boom and bust' fishery and associated decline in wild stocks has been documented in the case of *P. denisonii*, a highly popular endemic ornamental of the WG[6]. The same scenario (i.e. decline in wild populations) could also happen if initial aquaculture attempts lead to an increase in popularity. In this case, an increased demand can outpace an increased aquaculture supply[8]. The globally popular Banggai Cardinal fish (*Pterapogon kauderni*) is known to have become imperiled for a variety of reasons, one being the collecting pressure for aquarium trade[12]. Although this species is currently being reared in captivity, this has only added to their popularity, and not helped replace the reliance on wild collections[8].

A decline in wild species can also be the result of induced aggressive economic competition[13]. Technology for captive breeding and rearing of stream-dwelling ornamental fish requires a rather high level of investment and scientific expertise to succeed. In order to justify the initial expense of investing in a business of selling captive-bred ornamentals, it may become necessary for traders to increase their sales. This in turn will lead to a situation where they compete for market share and resort to wild collection to supplement captive production so as to meet an increased demand. Along with the increased availability of a species in the market, the price will decrease making it necessary to sell more individuals to maintain a current income. Such issues would have serious consequences, especially when exporters turn to launder illegally collected individuals from the wild as captive-produced fare. The ornamental fish industry in Kerala could be particularly prone to such laundering as this region lacks policies and/or legislations (licensing of farms or certification of fish) of any kind to regulate the aquarium fish trade. Such programmes, if enacted, could help both law enforcers and consumers in distinguishing wild-caught and captive-bred individuals.

An additional constraint in developing captive breeding as a conservation tool for endangered species is that the culture protocol is often not easy to develop. Some of the most popular endemic ornamentals of the WG, including *P. denisonii* are known to be extremely sensitive in captivity[14]. A high level of female mortality was the most important factor hampering the development of a captive breeding technology for this species[15]. This implies that even after such a technology is made available, farmers would have to rely upon repeated removal of wild stocks, especially for procuring good-quality broodstock. Thus, the mass adoption of captive breeding of such highly sensitive species would unquestionably lead to an increased pressure on wild populations. In addition, most breeders of ornamental fish are known to utilize wild stocks every two or three generations[16] (mainly because successive generations of captive-bred and farm-raised brooders show a marked decline in reproductive capability). Breeders and farmers would therefore pose the biggest risk to conservation of such species, as they would end up being the primary purchasers of wild-caught individuals. Project Seahorse[17] is a classic example of such a setting where aquaculture has not been promoted, as repeated collections for sustaining a culture industry for this species may actually result in the demise of its wild populations.

Popularization of captive breeding, although helps in reducing direct collection pressure, may also remove any incentive or reason to conserve wild stocks and their habitats at the local level[18]. Popularization of breeding technologies for many of the endemic and threatened fishes will no doubt displace habitat and ecosystem-level protection which are much needed and vital steps for long-standing conservation of these species. The policy statement of SSC of the IUCN[7] states that, 'whenever possible, captive breeding programs should be carried out in parallel with field studies and conservation efforts aimed at the species in its natural environment'. However, this is not what is happening in the WG region. There have been no efforts till date to implement any 'fishery management' or '*in situ* conservation' strategies to help manage the wild stocks from population decline, and captive breeding is seen by many as the only 'magic answer'.

Allowing the trade of endemic ornamentals will invariably lead to a loss in native germplasm. There are many species that have been exported from biodiversity-rich countries for several years. The hobbyists from the developed countries have themselves developed the breeding technologies and then taken over the market, and in some cases even lobbied for trade in wild-caught specimens to be stopped. Large-scale exports of endemic ornamentals of the WG to Singapore and the US will result in the development and standardization of breeding technology in these importing countries, which have better infrastructure to support such operations, along with easier access to

markets. The market for captive-bred endemics of the WG would then be taken over by the hobbyists in importing countries. They would in turn become the biggest suppliers of these species. Concerns have already been voiced in this regard, as it is known that researchers in Singapore and Israel are working towards developing a breeding technology for *P. denisonii*[15] and that the Malabar Puffer, *Carinatetraodon travancoria*, another endemic and endangered ornamental of the Kerala part of the WG is known to have been captive-bred and raised outside India, resulting in its price decline during the last few years[5]. Loss of native germplasm of many endemic ornamentals of Africa and South America, which are now being mass produced outside range countries, is well documented[8]. Artificial propagation is also known to seriously threaten the freshwater ornamental fish industry in Amazon[19], as it faces stiff competition in terms of pricing, variety and marketing strategies from the developed economies. The 44 strictly endemic species to this eco-region that are currently being exported[1] are immediately threatened and so allowing trade of these species will inevitably result in a high rate of loss of native germplasm and genetic property rights.

Low numbers should not be an automatic criterion for taking animals into captive breeding programmes[20]. The 'declining population paradigm'[21], where the focus should be on identifying and ameliorating the extrinsic factors that impact the threatened or endangered population, holds good for the native ornamentals of the WG. In the present scenario, the agent responsible for decline is known – 'overexploitation for trade', and a realistic treatment is nothing but a regulation of this trade. No single 'silver bullet', including captive breeding can benefit these species as much as a strong regulation on wild collection and trade, and preservation of native habitat.

Research and development in captive-breeding technology for endemic ornamentals of the WG needs to be streamlined, as several limitations exist in the current scenario. Although technologies for captive breeding have been developed for 13 prioritized ornamentals[22], this list includes only two of the ten most popular species in trade[5,23]. In addition, at least nine species for which a breeding technology is available are of low market value[5,23]. This makes one wonder about the priorities for selecting the species for developing breeding technologies – their market value, threat status or ease of breeding? Does the present scenario also imply that endangered species like *P. denisonii* and *C. travanocoria* are difficult to breed when compared to common ones like *Puntius filamentosus* and *Puntius fasciatus*, which may have been used as surrogates?

Finally to our focal question – should endemic and threatened ornamentals of the WG biodiversity hotspot be captive bred for international trade? Based on the above discussion, we obstinately argue that it is extremely unwise to promote the trade of such threatened and endemic ornamental fish, especially when the industry is in its infant stage and still has a long way to go with regard to development and standardization. We suggest that the government agencies rethink the use of captive breeding as an economic instrument to cash in on the boom in native ornamental fishes and rather focus on developing and implementing sound policies with regard to their collection (best management practices, fixing size limits, access restrictions and quotas), breeding and aquaculture (low cost technologies, sterile hybrids, involvement of local communities), stock enhancement (through ranching) and trade (certification, eco-labelling) with an eye towards their long-term sustainability.

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